News and Views

in the Biological Sciences

THE AIBS BULLETIN

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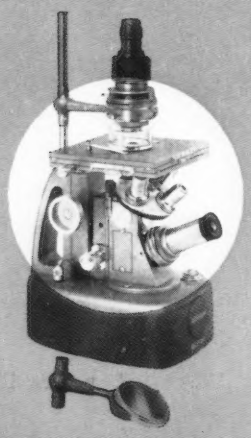

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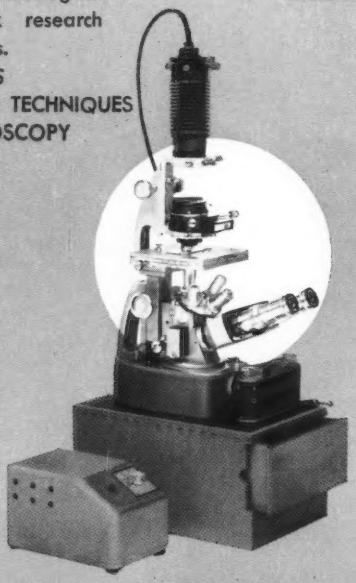

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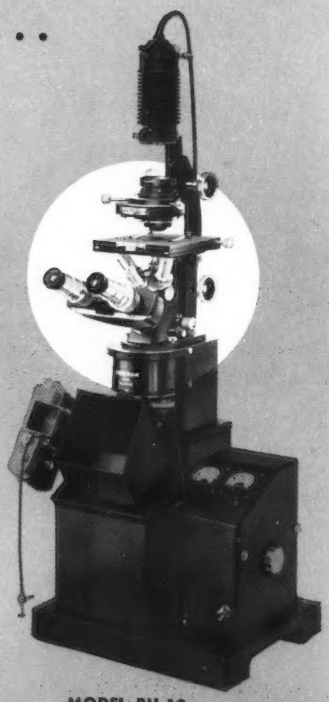

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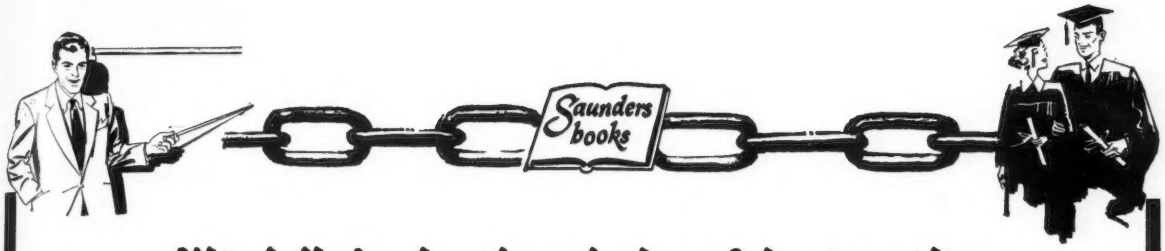

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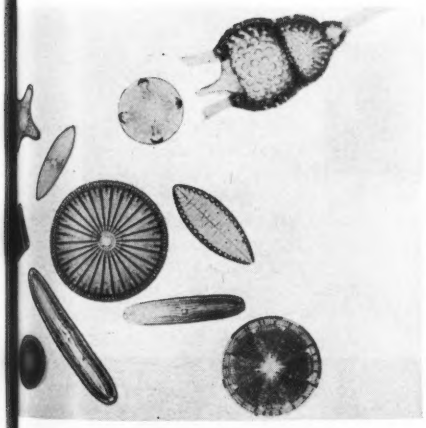

Cover Picture: Biological abstract from a variety of diatoms. Photograph and design by Alfred Novak of Stephens College, and George Schwartz of the Biological Sciences Curriculum Study of AIBS.

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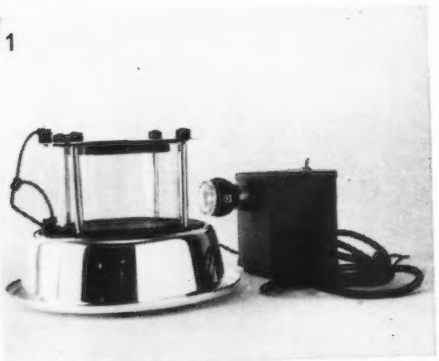

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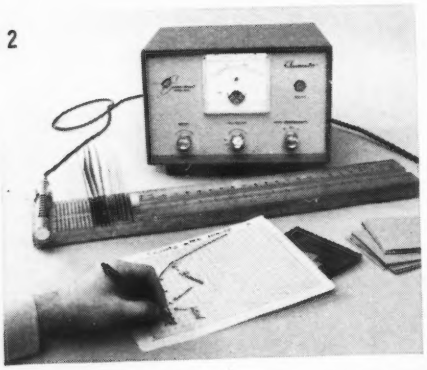

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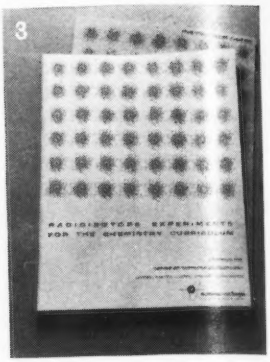

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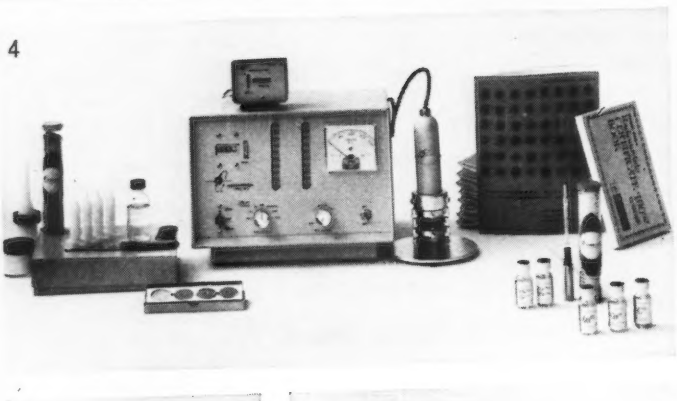

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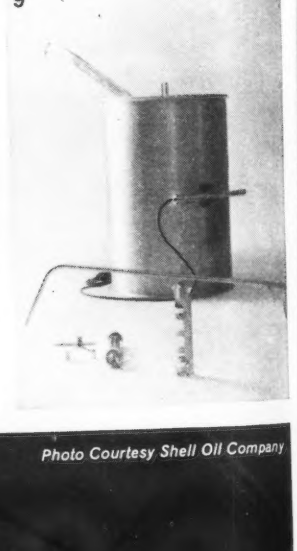

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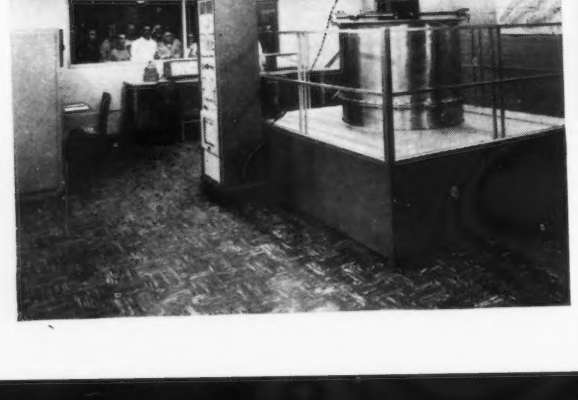

11

How to bring radioisotopes into the science curriculum

Read how these Nuclear-Chicago products help to enlarge the scope of education in the physical and biological sciences

RADIOISOTOPE procedures offer students penetrating insights into the laws of nature. Forward-looking educators are using the equipment illustrated at the left in lectures, for student experiments, and in research. These eleven photographs suggest the scope and completeness of Nuclear-Chicago's instrument line for teaching and research. Systems range from low-cost equipment for demonstration to sophisticated instrumentation for fundamental investigation. All are characterized by reliability, precision, versatility, and inherent safety.

Schools now employing radioisotope techniques will want to consider program expansion to take advantage of the newer products illustrated. Others may well regard the apparatus presented here as a planning guide.

* * *

Low-cost demonstration equipment for the nuclear age became a reality with the introduction of Nuclear-Chicago's Cloudmaster® and Classmaster®. The Cloudmaster (figure 1) is a continuously sensitive cloud chamber that provides a spectacular display of ionization tracks caused by alpha, beta, gamma, and meson radiation. The Classmaster (figure 2) is a complete system for demonstrating radiation absorption, scattering, geometry effects, coincidence loss, etc. In addition, it permits simple tracer experiments using license-exempt radioisotopes. Both instruments enjoy wide acceptance because of their simplicity of operation and the vivid, easily-understood presentations they make possible.

Thirty-three student experiments are contained in a new 187-page experiment manual and 60-page companion volume of instructor notes (figure 3) developed by Nuclear-Chicago under contract with the Atomic Energy Commission. Model 4001 nuclear training system (figure 4) is offered with isotopes, sample preparation equipment, and instruments to perform all the experiments covered in the manual. The system features ease of sample preparation using the chimney funnel shown in figure 5.

Model 4001 is supplied with the long-lived radionuclide set RNS-110 (figure 6) and the radionuclide certificate book RCB-1 (figure 7) with which the instructor can order short- or long-lived isotopes as they are needed. Neither requires an AEC license to purchase or use, and both are available individually.

As student mastery of radioisotope procedures advances, department heads will next want to consider establishing a complete nuclear laboratory for precision handling, detection, and counting of beta- and gamma-emitting isotopes. Such a facility has valuable application to studies in biology, chemistry, physics, and biochemistry at both the graduate and undergraduate levels. A typical installation is pictured in figure 8. In the left foreground is the Model 701 liquid scintillation detector with Logic scaler, and at the right is the Model C120 automatic sample changer for gamma-emitting liquids or solids in test tubes. In the background, from the left, are the Actigraph II® system for scanning radiochromatograms, a low-background automatic sample changer for solid beta samples, and the Dynacon® electrometer for high-efficiency measurement of beta samples in the gaseous phase.

At this stage, the ideally equipped university will lack only the means to create its own radioactive isotopes and to study reactor techniques and fundamental nuclear properties. For these basic needs, Nuclear-Chicago offers a three-step program.

First, undergraduate departments will choose the NH3 neutron howitzer (figure 9) for experiments with low-level neutron sources, production of short-lived, low-intensity radioisotopic tracers, and low-flux activation analysis.

Second, the science and engineering faculties will often cooperate in establishing an advanced training facility centered on the inherently safe Model 9000 subcritical assembly (figure 10). Characteristics of this water-moderated, natural uranium assembly are nearly identical in nature to those of a full-scale power or research reactor, and the student readily masters the fundamentals of reactor theory and design.

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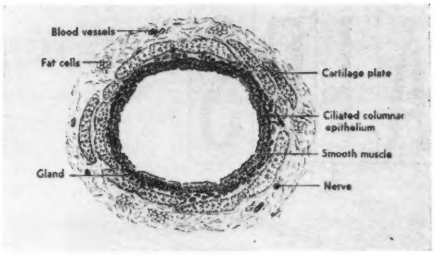

Bronchus.
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By GERRIT BEVELANDER, Ph.D., New York University, New York, N. Y. Published August 1961. 288 pages, 6½" x 9½", 183 text illustrations, 4 color plates. Price, $5.75.

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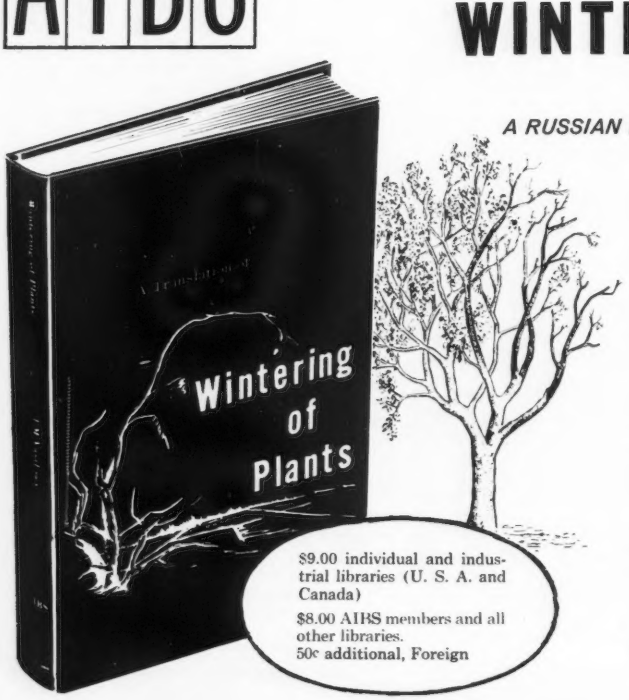
by I. M. VASILIEV

A RUSSIAN MONOGRAPH TRANSLATION (EIGHTH IN A SERIES)



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WINTERING OF PLANTS, published by the American Institute of Biological Sciences, is one of only two books on this subject in the English language. Dr. Jacob Levitt, Professor of Botany, University of Missouri, who is the editor of WINTERING OF PLANTS, is the author of the other book, which is entitled, HARDINESS OF PLANTS, and was published in 1956.

According to Dr. Levitt, the U.S.S.R. has had at least three monographs on this subject during the past twenty years. Vasiliev's is the most recent.

The book deals with one of the fundamental problems of plant physiology—hardiness of plants. The author approaches the problem from the ecological, physiological and genetical points of view. Each part of the book is treated very competently and includes a critical review of pertinent literature, both Soviet and Western (980 titles in Russian and 385 in other languages are cited). The author discusses the breeding of cold-resistant varieties and the problems of "jarovisation." The experiments of Michurin are reviewed in some detail. Contrary to the popular belief of Western scientists, Michurin did not claim to have produced his remarkable fruits and berries by some "somatic hybridization" but by standard methods of hybridization and selection.

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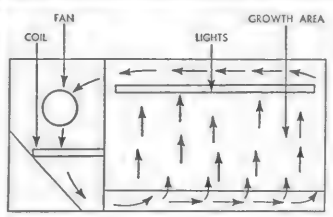

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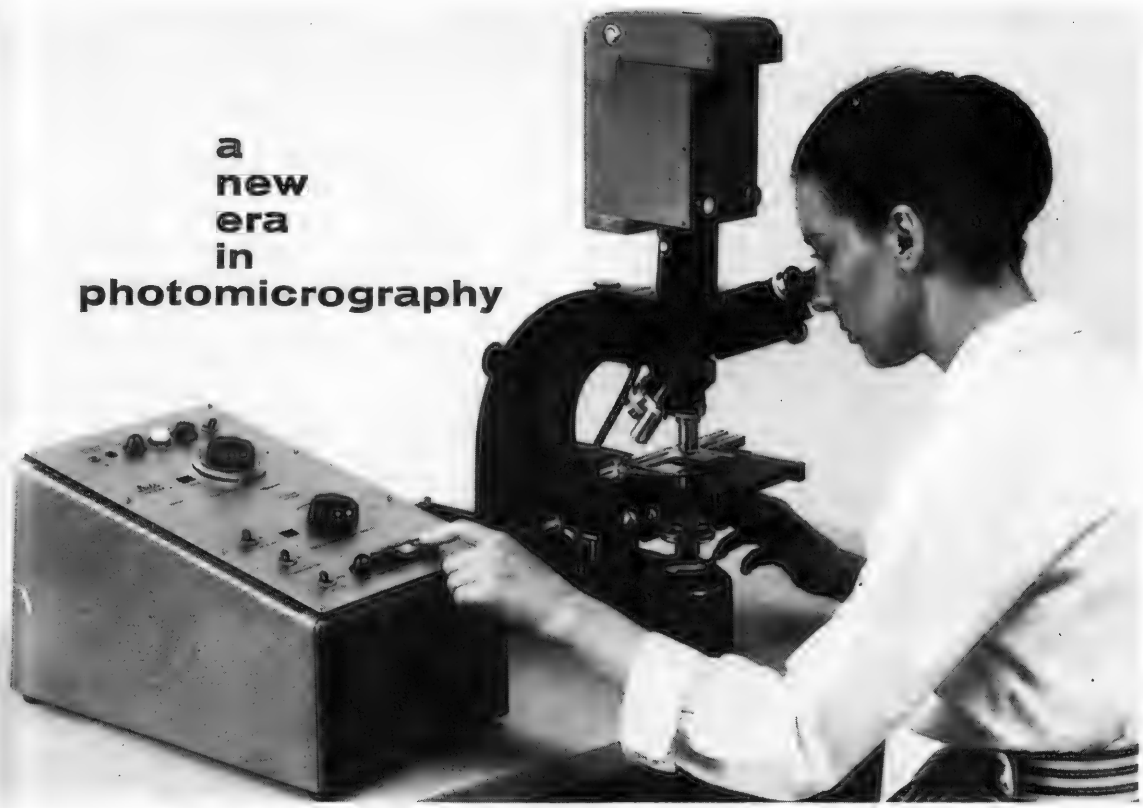

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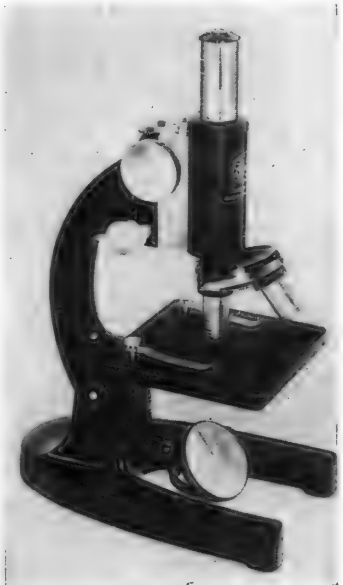

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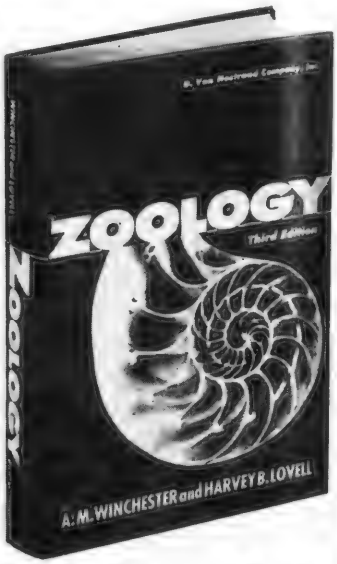

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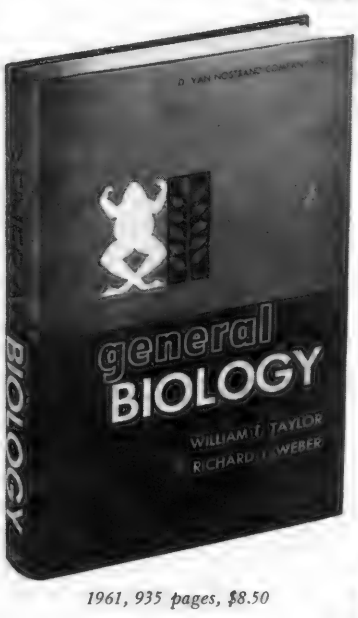

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Survival[1]

NEVER BEFORE have the conditions for the survival of human life, and with it much other life on this planet, been in so unstable an equilibrium, one so subject to ever more irresistible deflection in either a positive or negative direction, according to relatively minor circumstances that might temporarily hold the balance of power. Moreover, never before have the circumstances deciding the direction of swing been so open to control by man's own judgment, provided only that he can be brought to exercise it in time, with sufficient unity, and in the light of facts already known to science.

The Uniqueness of Life's Method of Survival

To view our subject in perspective we may recall that even inanimate things engage in a kind of struggle for survival. Thereby the particles fall into ever more lasting arrangements, and cycles of movement, of standard types, involving increasingly complex aggregations on a number of very different scales of space and time and different levels of structure. Moreover, under the conditions that were to give birth to living matter the multiplex valence and versatile combinability of carbon, nitrogen and phosphorus allowed the formation of molecules of unusual complexity.

However, a sharp discontinuity in the type of survival and evolution occurred as a result of the formation of *genetic* material. This consisted, as has now become evident, of chains whose links were nucleotides, or nucleotide-forerunners. The prime faculty of these chains was that of taking from the medium about them free-floating links and arranging them into complementary chains, which in turn, by forming complements to themselves, gave rise to replicas of the original chains. For the most part the replication gave a faithful copy, but by an occasional slip, or a change occurring in the original chain, a chain with a somewhat altered linear arrangement of links arose. Then when this mutant chain replicated, the replica repeated the new pattern. Thereby that type of survival had been brought into being, characteristic of biological evolution, that we call natural selection. An essential part of the picture was that this self-copying ability was possessed by a substance of high chemical potency, capable, at least when given access to free particles like the links composing it and to other kinds of organic molecules as well, of carrying out syntheses of very diverse kinds, depending on the arrangement of its links. No other type of substance having this crucial combination of properities is known.

Arising in the primeval brew, and subject to repeated accidental mutations in their pattern and length, the chains of the different types must have had somewhat different rates of multiplication, and unlike chemical properties. Those rare mutant chains increased in number more in any given situation that were faster in multiplying, less vulnerable, or better able to influence alien materials in ways that helped them to survive and multiply. Multiplication, not mere survival, was essential here. That was because the vast majority of mutations are (as expected) detrimental, advantageous ones being very rare, and because any given mutation arises in only a single individual. For, in consequence, the *rare advantageous* mutant has had to become multiplied until it was very abundant before still another advantageous mutation was likely to arise within or alongside of the same genetic material, so as to allow a further step to be incorporated with the previous one.

As this process continued, the nucleotide chains took on more and more of the character of artisans, fashioning the material around them in their own behalf ever more elaborately, until finally they had evolved so far as to construct about themselves those factories, full of animated tools, that we call cells. Proceeding on from there, some types erected for themselves multicellular bodies of increasing organization, and even colonies of these bodies. Moreover, they often caused more or less extensive operations, favorable for themselves, to be carried out in the adjacent milieu. In time, through far-flung partnerships between diverse types, practically all of the outer envelopes of the planet be-

[1] The principal address delivered at the 1961 AIBS Meetings at Lafayette, Indiana.

came worked over and transformed by life, and even the rock of the crust, for miles down, has come to be largely composed of the detritus and relics of the multiplication process, much of it to be used again.

Granting the possibility of changes of diverse kinds in any system, the cardinal principle involved throughout all this course of events in biological systems is not merely survival, as in the evolution of inanimate things, but *multiplicative* survival, and not merely multiplicative survival, but *differentially* multiplicative survival, which in the long term constitutes biological evolution by natural selection. Its characteristic result is the production of organizations, "organisms," and groups of organisms, of otherwise unparallelled complexity, virtually all of whose parts and features cooperate harmoniously, as a system that works to promote its own causative process, the differentially multiplicative survival of the nucleotide chains that are now almost lost to view in its midst, but that remain as its generative core. The whole of sexuality, for example, exists only by virtue of its contributing powerfully to the differential character of this multiplication process. All this is utter functionalism, and it may also be called adaptation. The functions have no ulterior end beyond self-security, gained through differential self-increase. Yet the word "self" as used is not accurate, inasmuch as the potentiality of unlimited change in that self allows the course taken to be not truly cyclic but spiral. Moreover, the axis of that spiral has ever and again taken new directions, has branched repeatedly, and in some of its lines has pushed out ever further.

The Race Is Not Always Won By the Fastest

It may be objected that if the fastest multipliers always prevailed, life of today would not have passed beyond the stage of microorganisms, since they can multiply much the fastest. This objection overlooks the fact that they can multiply faster only under conditions so favorable as to require of life a minimum of other activities than multiplication itself. Under such circumstances a virus that has little more to do than replicate its nucleotide chain multiplies fastest of all. A typical one-celled type, whose nucleic acid must in addition build up an elaborate protoplasm, runs a poor second. And a multicellular form, whose initial nucleic acid has to make a far bigger soma still, relatively to its own bulk, trails far behind, even when we make due allowance for the greater number of reproductive units it also produces. That the genetic material of the multicellular form does not really lack the capability of rapid replication is illustrated by the zygote nucleus of the fertilized Drosophila egg which, supplied with all the constituents, ready made, that are needed in its replication, doubles itself about every nine minutes, almost as fast as a phage chromosome does in its bacterial host.

Although the maximum rate at which the genetic material can carry out the reproduction of the organism necessarily diminishes as that material takes on additional jobs, nevertheless the more elaborately equipped forms, when placed under circumstances where the difficulties of life render their equipment useful, succeed in multiplying more surely and in the long run faster than the free-and-easy-going forms, who live by gobbling up handouts. Thus, from top to bottom, existence does remain a race to multiply, but there is room for many types in this game.

Another reason why the fastest gross multiplication rate is not always the fastest net or over-all multiplication rate is that an organism may overreach itself in multiplying. For example, it may use up its means of subsistence faster than that becomes replenished, or its more crowded circumstances may be conducive to epidemics and infestations, or lead to destructive forms of intraspecific strife. And an organism that protects and nurtures its young cannot do as well by too large numbers of them. Where such possibilities exist, those subdivisions or small groups of the species that have too high a gross multiplication rate tend to be replaced by the groups having a more nearly optimal rate even though, *within* each small group, there is often a tendency for the fastest multipliers to be selected. Thus the selective influences may be complexly balanced, and tend to establish those short-term gross rates of multiplication, or "pressures," that result in the highest net rates, or "effective rates," over the long term. Eventually the resulting slow multipliers may even find it possible to reoccupy the relatively luxurious domains of their early ancestors, there to defeat the naive fast multipliers in portions of the latters' home ground.

It is sometimes held that such terms as higher, lower, and progress are misnomers, since every existing form necessarily has a niche in which it is supreme. Moreover, many relatively simple types, because of the high rate of their multiplication when their supplies are ample, the ease of passive dispersion allowed by their small size, and in some cases their ready dormancy and/or some specialized physicochemical faculty such as resistance to heat or the ability to derive energy from the oxidation of sulfur or iron, may attain far greater numbers and even total volume, and succeed in occupying a larger area, than forms much better equipped for mastering diverse environmental difficulties. Nevertheless, there is justification in designating as more advanced or higher the types that are more effectively fitted out to surmount varied obstacles and to wring a living from situations refractory to the primitive forms. In general, the more advanced the type, the better developed are the mechanisms that buffer it, by internal readjustments, against environmental changes and vicissitudes. The better developed also are its means of reacting actively upon its environment, evading dangers, finding and utilizing environmental opportunities, and even, as a part of this process, modifying its general surroundings in its own interests.

It is true that even among these higher types many have taken, secondarily, to concentrating their abilities more narrowly, on the more effective exploitation of relatively limited kinds of situations. Often these specializers have regressed in one or more important respects. Others among the higher types, however, have maintained or increased their versatility, and have come to live by skimming the cream, as it were, from many kinds of bowls. In the main, it has been among these jacks-of-all-trades that the forceful new evolutionary breakthroughs have occurred: those that have led to the exploitation of radically new means and spheres of living. Thus have arisen the great new

stems of evolution that characteristically put forth, on a higher level than before, a series of divergent sprouts which, for a time at least, have changed rapidly and become abundant.

Although any given form in progressing biologically had to outmultiply its competitors in the situations or types of contest peculiar to its own way of life, nevertheless it sometimes became subjected later to increasingly difficult circumstances. This might happen, for example, when some other evolving form encroached upon it (sometimes by means of changes which the other form adopted in reaction to the first form's own developments). In consequence, the numbers of the first form might actually diminish for a time; that is, its net multiplication rate might become less than 1. Yet even then the form in question might be continuing to progress by an intra-species process, often more or less cryptic, of differential multiplication, provided only that further advantageous mutations or combinations of mutations were arising in it that gave their possessors an advantage over the original type. In other words, the advancing types were still outmultiplying their most intimate competitors.

There is another kind of differential multiplication, again largely cryptic, which is far more widespread, occurring at a considerable intensity in any population that is not actually degenerating. It exists even in the numerous cases in which all roads to substantial genetic change of a species have been somehow blocked, and even if its total numbers are at a standstill or diminishing. This consists in a higher net multiplication rate on the part of those genetic types that are more nearly normal than of those that carry a heavier load of detrimental mutations. This relative overproduction of offspring by the genetically sounder individuals must ordinarily be great enough to compensate for an equally large contingent of the population that has been damaged by newly arisen mutations. Usually this process of maintaining the genetic quality is almost certain to be occurring to an adequate extent.

The Role of Cooperation in Competition

Although all differential multiplication is somehow competitive nevertheless, as was first pointed out by Darwin, cooperation also has been of immense biological value, and it has been both an effect of evolutionary progress and a cause of it. However, to succeed genetically, cooperation must itself be competitive. That is, it must be associated with some form of competition between the groups within which the cooperation is occurring.

The most obvious situation of this type is one in which an individual extends help to members of his own family, or of some small group consisting largely of his close relatives. Since these individuals are more likely than others to carry the same genes as those that actuated him in furnishing the aid, his actions tend to promote the multiplication of these very genes for mutual aid. The more closely related those helped are to their helpers, the more effectively must this type of selection work. By its means a genetic constitution is selected for that predisposes the individual to give aid most of all to his family and secondarily to a rather small group of immediate associates, but ordinarily to react to outsiders as beyond the pale.

There is a second type of selection for cooperation, which draws its lines in a different way, although the areas of incidence of the two types usually overlap considerably. We may call the principle on which this second type is based *reciprocation*. To start this going there must first be the condition, however it may have come about, that some feature of the activity of one individual or category of individuals, call it A, happens to be helpful to another individual or category, B. A and B may or may not be genetically related. Now when this condition pre-exists it becomes advantageous to B, the one helped, to use any means it may have of promoting the helpful activity on the part of A, and one way of doing so is to somehow further A's own interests, that is, to help A to live. This being the case, it then becomes to A's advantage, in turn, to help B more, since by so doing he helps himself. Thus a kind of mutual-benefit is formed, that tends to become self-enhancing in its positive feedback, and to lead to increasing "co-prosperity."

Of course this sort of relation usually exists in its most pronounced form between reproductive consorts, and it also tends to be marked among other members of the same family. Going further, it is expressed in diverse types of mutual aid even between unrelated individuals, and in these cases it includes, on a psychological level, friendships. The genetically based psychological drives here involved do not usually tend to take the form of a calculating self-interest but to be altruistically oriented. They tend, in fact, to be largely the same drives in the case of both types of selection for cooperation. However, the direction of expression of reciprocationally based drives is primarily toward those other individuals who render aid to the given agent.

Also characteristic of reciprocation is that it is not subject to any limits of genetic relationship whatever. Thus it has been the mechanism of establishment of all kinds of symbiosis, ranging from such associations as those of lichens or green hydras to those of insects with flowering plants and of ants or human beings with their cultivated plants and domestic animals. In the case of both types of cooperation, be it noted, the selection works by way of the advantages that the individual's behavior ultimately affords for the multiplication of the individual's own genes (or genes of effectively the same kind, present in its associates), as compared with the competing genes that are not so conducive to cooperation.

In a more general way, even our ecological systems, including the biotic cycles of the elements, are examples of reciprocational selection. Here, however, there is no appreciable tendency for any given individual, B, that is helped by A, to reciprocate by helping that particular A which helped it (or some other A so closely related to the first one as to be likely to carry the distinctive genes to be selected). In consequence, the selection in favor of cooperation cannot be nearly so direct or efficient. It can only be of the long-term, indirect type that operates over considerable periods, between different ecological systems as wholes.

In any such system there will be frequent violations of its harmony, ecological cancers as it were, wherein

a given group or combination of groups takes advantage of the system's resources by embarking on a course of self-aggrandizement that weakens and diminishes the biotic turnover in the system as a whole. Although such irruptions tend eventually to be taken care of by the longer-term selection that acts among the larger associations as wholes, nevertheless this is so slow and inefficient a process that in any existing system there are always some "runaway" types, that have not yet been brought under control. Hence the total biotic turnover is usually much below the theoretical maximum. It is usually especially low when man interferes with the system. A somewhat similar situation not infrequently exists within a single species, where given lines of descent, that are in a sense social parasites, overmultiply, to the detriment of the species as a whole. These can be weeded out of it, if at all, only by a stringent inter-group selection.

This brings us to a converse kind of mechanism, that we may term negative reciprocation. It goes beyond ordinary competition in that A and B go out of their way, as it were, to be obnoxious or destructive to one another. Once this begins, we have the germs of a biological arms race that can range from the active pre-emption of supplies or living areas to the production of antagonistic chemicals, the encouragement of one another's other enemies, and physical attack. It can apply not only between species but between different communities of the same species, as in ants, or between all like-sexed adults, as in some spiders. Occasionally, as in some kinds of wolves, an unstable equilibrium exists between mutual aid and opposition, such that whichever of these gets started tends to become intensified.

Not infrequently there is a development of cooperation in some activities and circumstances and of opposition between the same individuals in others. For instance, a mechanism may become established that replaces cooperation by ordinary competition or even by negative reciprocation under conditions of famine. Moreover, there is often an intermediate situation, well illustrated by the untutored chimpanzee who freely breaks his morsel into two "halves" and gives his weaker companion one, which is invariably the smaller half. In any case, the ultimate function that the behavior tends to serve is differential multiplication.

Of course, non-reciprocal relations also exist. Such are the cases of parasites or predators and their prey, so long as the offender, A, is chiefly a source of difficulty or destruction for the injured party, B, while at the same time B remains useful to A. In such a case, however, the A's by reducing the number of B's too much, as their short-term selective process lead them to do, work against ther own long-term interests. Then, if the B's become more vulnerable as they grow scarcer, they may actually be exterminated, while the A's may have additional means of subsistence and survive, although in reduced numbers. On the other hand, in the frequent cases in which the B's become individually harder to attack as they become scarcer, there is (as calculated by Poincaré and by Gause) a tendency for population cycles to occur, in which the phases of A trail those of B. But in any such system inter-group selection occurring among the A's favors types which although benefitting by the B's are not so virulent or so destructive to them. At the same time, the B's tend to build up resistances against the A's, and most especially against the most destructive aspects of the A's attacks. Thus, at long last, such systems may sometimes turn into a kind of symbiosis, as Altenburg long ago pointed out in connection with parasitic microorganisms. This illustrates the proposition: "If you can't beat 'em, join 'em."

In the involvements among many species the relations of competition, cooperation, and attacker versus victim can be highly complicated. But they usually work out to a fairly stable balance of types, the "climax" situation, that it is very difficult to upset permanently. Here the differential multiplication rates are in active operation, yet for the most part they succeed only in maintaing things much as they are over a considerable period.

The Dawn of Understanding

The advent of a central nervous system with its complex reactions, including instincts and learning, did not alter the principles of these interrelations. For these physiological processes served, like the others, as tools for the differential multiplication of the genetic material. Into the central nervous systems' structures, therefore, there became incorporated mechanisms leading to competition, cooperation with others of its kinship group, reciprocation both positive and negative, and one-sided offense and defense. The individuals were provided by their genes with inborn behavioral drives for carrying out these operations under the appropriate circumstances, and learned by their own experiences to satisfy these drives more effectively, thus promoting their multiplicational survival. Many times, short-term selection overdid or misdirected certain drives, and a longer-term selection, often at considerable cost, corrected these mistakes by reducing or exterminating the small group or the whole species or higher category. Often too, a given development that was advantageous enough in its original setting became dated by changes in competing populations or in other features of the biological or physical environment, and had to give ground in consequence. Yet through all of this the learning process in many of the lines was sharpened, still in the interests of multiplicative survival.

Among our ape-like ancestors, the genetic increase of learning ability, now meriting the designation intelligence, occurring in a group having such exceptional potentialities as they had for manipulation, cooperation and communication, gradually raised them above the threshold needed for the effective transmission of learned skills, attitudes, and concepts from one individual to his companions and from the elders to the young. There ensued the accumulation of these learned reactions from one generation to another that we term cultural evolution. By means of this process, which could be inordinately faster than progress through differential multiplication, the ordinary individual was enabled to incorporate much of the wisdom gathered by the race as a whole through many thousands of

generations (along with many of its follies also, of course), as though he had been a super-Methusaleh.

During much of this time, moreover, the ancient selective processes of differential multiplication, acting both between individuals and between small kinship-groups, must have worked ever more effectively to raise the genetic bases of intelligence, manipulative skill, communication, and cooperation in general, because the ways of living opened up by culture afforded increasing opportunity for the exercise of these very faculties. Both because of this genetic advance and because of the growing means of enhancing culture provided by culture itself, the rate of cultural progress tended to follow a curve that ascended ever more steeply. Thus, hundreds of thousands of years elapsed between the first use of fire and the agricultural revolution but that was soon succeeded by the rise of urbanization and then of an accelerating science. And although environmental and historical factors caused these developments to be very unevenly distributed in both space and time, and to follow different sequences regionally, nevertheless today the latest innovations are spreading fast throughout mankind.

Although we call man the first toolmaker we should recall that the use of artifice, although in an unconscious way, has been a prime characteristic of the genetic material ever since its advent, and that our earth's present envelopes are the genes' handiwork, even as our own organisms represent one group of their robots. It is a commonplace, however, that man himself, within an evolutionary moment, has extended to an unparalleled degree the creation of artifices, thereby ever further altering the environment, by the cooperative use of his culturally self-enhanced intelligence and experience. This new factor of far-seeing conscious direction, especially in its modern form of science and technology, has become so versatile, powerful and far-reaching, and at the same time so subject to self-modification, as to cause our present culturally induced changes and cultural evolution to be on a scale of magnitude, complexity, and speed incomparably vaster and faster than the events of biological evolution ever were.

The chief reasons for the swifter progress in cultural than in biological evolution are, first, the element of pre-adaptedness, based on foresight, in the origination of cultural innovations as contrasted with genetic mutations, an element that increases with the advance of culture; second, the fact that the spread of cultural innovations is far faster than the differential multiplication needed to spread mutations; and third, that the extinction or modification of innovations, like their origination, is often hastened by judgment, based on experience, that is, by hindsight, and is similarly capable of swift transmission. However, the factor of foresight seldom insures that an innovation will really work out advantageously, especially in the long run. And the factor of hindsight too is often imperfect, especially when a given feature affords or seems to afford immediate benefits but is injurious over a long period. Moreover, human societies are notoriously loathe to concede their failings.

In view of these imperfections in cultural self-enhancement it is fortunate that throughout most of prehistory there was a subdivision of humanity into many small semi-isolated groups. For this allowed an intergroup natural selection that weighed these groups according to not only their genes but also their cultures. Thus, markedly detrimental cultural characteristics tended to be lost through the dying out or cultural absorption of the small groups possessing them, and the remaining cultures were on the whole those more conducive to multiplicative survival.

The Challenge of the Brotherhood of Man

Paradoxically, however, this corrective selection among cultures diminished as the more advanced cultures became larger and fewer. Their growth was an expression of their population increase, territorial expansion, and transplantation on to other groups, occurring at a time when more effective means of communication, transportation, and social organization were making it possible for an ever larger group to be held together as one cooperative unit. Now, as this happened, the process of intergroup natural selection, choosing among these fewer, larger groups as wholes, inevitably became ever less potent, and less discriminating in regard to the finer individual features of cultures. In fact, the overriding features that caused one large group to prevail culturally over another one were often of a military or otherwise coercive type that was actually unfavorable for peacetime progress. Meanwhile, however, the cultural steps being taken were becoming more numerous as well as individually larger. In view of all this increase in cultural drift, it is not surprising to find that some of the widespread cultures went off on such destructive tangents as the Aztecs' mass human sacrifices and Medieval Christendom's Crusade of Children. Rather, the wonder is that we have managed to get so far so fast anyway, and have not yet gone under.

But despite these dangers associated with unification, the high techniques of modern culture have now become quite incompatible with separatism. If general catastrophe is to be avoided, world-wide agreements are imperative that will allow these techniques to be used for all humanity in comparable measure everywhere. Basic to this, moreover, is the requirement that all peoples be enabled to develop the scientific understanding, the humanistic outlook, and the social leavening without which the techniques would be subject to misuses imperiling mankind in general. The great sacrifices that we of the presently more fortunate peoples must now make to attain these world goals as rapidly as possible are not comparable with the severity of the retribution that would result from our pursuing a policy of too little and too late.

At the same time, however, we must choose our course with the utmost caution and tact, and with far-seeing sagacity. To rush into unification on the easiest basis that presents itself would be to court multiple disaster. We must be sure that the world "society," "federation," or "co-existence league" embodies all the basic principles indispensible for its self-rectification and improvement, and not elements likely to result in its eventual undermining.

What should our guidelines be here? Since in a

world society there will be no intergroup selection among cultures to keep them steered in favorable directions, mankind will henceforth have to rely solely on the only possible alternative: increased foresight and hindsight, adequately implemented. And as the steps taken grow in number, in size, and (like the H-bomb) in finality, conscious planning and experimentation become ever more necessary and demand ever greater wisdom. Fundamentally requisite as a basis for wise decisions is the scientific method. This consists, in simplest terms, in examining every question in a spirit of *searching, creative objectivity.* For this purpose there should be freedom from all authoritarianism, dogma, and (what is worst of all) conscious deception, and ample scope for honest criticism and countercriticism. But this only sets the stage for the main work. It is carried out by the activity of wide-roving imagination, harnessed speculation, ruthless analysis, coordination with other relevant knowledge from no matter how remote-seeming a sphere, discerning calculation, enlightened observation, versatile probing, and well-designed testing. If all this seems like a scientist's Utopia it has nevertheless become a basic need of today and tomorrow and of our whole future. It has, moreover, become necessary for such a mode of procedure to prevail throughout the whole domain of human understanding.

However, this could never come to pass under the condition of dictatorship over thought or over its expression, no matter whether this was exercised by a well-meaning majority or by a small coterie convinced that it had all the answers. There is no short-cut or substitute for the kind of honest muddling through, insight, wrangling, waste, and serendipity that constitute science's method. Moreover, people can do their best work in science, just as in any art, only when they *play very hard, and with true abandon.* It follows that the politician or practical man who tries to impose upon science his scheme for its coordination is poisoning the goose that lays the golden egg.

It was through the rise of large sections of humanity, continued through many centuries, out of their past serfdom—economic, political, moral and intellectual—that science and technology managed to attain the level that now brings within reach the possibility of an all-round good life for all men. But the realization of this opportunity requires the extension to the whole world of this heritage of generalized enfranchisement. We would buy our own and our children's physical lives at a shameful price if to secure them we were now to abandon this hard-won heritage, so vital for all the world, by yielding to any type of authoritarianism. For by this act we would relinquish the essence of science and, along with it, the means of continuing to think and act as responsible, humane beings, and any world society would be vitiated at its core. This consideration, taken in connection with a realization of how justifiably impatient are the large sections of humanity who have not had the benefit of a long tradition of free and scientific thought, and how weak is the grasp of it even among many in our own midst, serves to point up the difficulties confronting us in the choosing of our joint course. It also shows the crying need for everyone who might appreciate these crucial points to lend his ear, his voice, and his hand during the continuing emergency of our time.

Dr. Muller shown delivering his address.

The Price of Improvidence

Our survival as rational, cooperating beings throughout this prolonged emergency and beyond it requires us to escape the misuse not only of today's unparalleled techniques of mass extermination, mass temporary physical incapacitation, and mass thought control. As biologists we should realize that just as serious in the long run would be the continuance of such present malpractices as (1) the swift despoliation of the food and fiber resources of our planet by our destructive methods of forestry, cultivation, stock raising and wildlife eradication; (2) our making of a virtual bonfire out of our irreplaceable stores of readily available fossil energy; and (3) our failing duly to conserve our minerals. The deserts left in vast areas occupied by some of the great previous civilizations afford mute testimony to the completeness of the self-effacement brought about by men exercising the kind of foresight and motivation that goes after the biggest immediate gain and display, heedless of the long-term results. Thus the earth's whole ecological system, built up through billions of years, is being upset drastically by one upsurgent form, ourselves, in such a way as to reduce enormously and for a long time to come the total biotic turnover, including the turnover ultimately available for us.

It is true that we of today are fortunate because during this grand spree of exploitation of our planet's riches our science at the same time has enabled us to come upon unsuspected sources of energy and materials, and new means of converting and utilizing them. We cannot yet know how practicable our developments along these lines will be, what possibly greater dilemmas they may confront us with, nor whether they could be realized soon enough to avoid irreversible set-backs in

the meantime. But in any case their effective utilization in the interests of all mankind—and no longer is it realistic to think in lesser terms—would require a type of over-all foresight and control much wiser and more far-reaching than any that men have practiced hitherto.

Closely related to this problem of instituting practices that will make possible the better long-term utilization of the world's goods is that of getting people so to adjust their numbers to the goods available as to allow them to live lives of increasing accomplishment and fulfillment for themselves, and promise for future generations. We have seen that although the road of survival for life is by its multiplication the more advanced types multiply more slowly but more inexorably. In general, the more advanced the life processes and equipment of an organism, the lower is the *gross* rate of multiplication which allows it the most secure and highest *net* rate of multiplication over the long run, and which best advances its interests as a species. Thus, inter-group natural selection has tended to establish for each species a gross multiplication rate optimally suited to its own way of life.

It is a commonplace that the gross multiplication rate natural for man is very low, by comparison with that of most animals, because of even primitive man's relatively advanced practices of protecting and providing for his family and himself. However, man's present scientific and technological revolution has more than tripled the probability that a human being born in our time will survive through the age of reproduction (if we neglect the possibility of an all-out war), and it has therewith tended to triple man's net rate of multiplication. This situation makes it imperative for man today, if he would effectively utilize and enjoy the benefits of his civilization, to reduce his gross rate of multiplication by a corresponding factor. In our own country, even though we have greatly reduced it by voluntarily applied methods of preventing conception, nevertheless we have left it at a level which if continued would in about 40 years double the population, and in 400 years double it ten times, that is, multiply it a thousand fold, up to 180 *billion*. Moreover, the population of the rest of the world, now some 15 times our own, is at present increasing, on the average, at about the same rate as ours, and its rate of increase is itself increasing. Obviously, however, a mere continuance of the present rate of increase would be physically impossible, even at the wildest estimate of how much the production of food and other necessities could be expanded.

The rate of population increase will have to be slowed down in one or both of two ways. The rational, humane way is to slow it down intentionally, as by an increased use of contraception or voluntary sterilization, in reaction to a realization of the danger. The only other way is to allow the increase in numbers to be slowed down involuntarily, that is, as a result of an increase in mortality, morbidity, sterility, and misery brought about by *per capita* shortages in the means of subsistence. That course would constitute a slipping down of humanity into a universal slum, a slum not only far vaster but also far more shameful than any previously known, inasmuch as it would have been foreseen, and would have come about in the face of knowledge of how it could have been avoided.

In many places, this prospective slum is already on the way. If this situation is to be kept from running beyond control a world-wide, utterly frank and forthright effort to concurrently increase production, without despoliation, and decrease reproduction, without compulsion, will be needed. As yet, however, neither the governments nor the political parties of any major countries except Japan and India publicly recognize the gravity of this situation, even though just one breach in the dam lets loose the flood. It may be hoped that, given improved living conditions, widespread education in this matter, more intensive research on inexpensive means of readily and effectively controlling reproduction, and the adequate distribution of these means, it will be sufficient to leave the further course of events to purely individual determination. However, it may ultimately be found necessary, in order to balance the total budget of human life, to resort to some such measure as a tax on exercising the privilege of reproduction. This would presumably be graduated according to wealth somewhat as income taxes are. The same in principle, but more practicable under some circumstances, would be bonuses for *non-reproduction*. This is a measure long ago suggested by H. L. Mencken and now applied in India in some cases of sterilization.

The Genetic Dilemma

The problem of population goes much deeper, however, than that of keeping in the black in regard to resources versus number of lives. We have seen that the progress of living things, and even the mere maintenance of a *status quo* in them, has depended not just on their multiplication but, more precisely, on their *differential* multiplication, though that has often been cryptic. Yet our modern science, technology, and social organization has created the unprecedented situation that, in man today, the differential character of his multiplication is being in large measure done away with. This has come about in two main ways.

One important form of our differential multiplication, noted earlier, has consisted of the natural selection that occurs between numerous small groups of related individuals. The fading out of effective subdivisions within today's large populations, that is so essential a feature of modern culture, cannot help but vitiate this inter-group selection (except as it may still apply, though in much reduced degree, between families). It was pointed out previously that such selection necessarily played a major role in guiding social evolution itself along functional lines. But it must have been equally important in genetic progress and genetic maintenance, especially in regard to the genes conducive to fellow feeling and to sociality in general.

The other main form of differential multiplication is intra-group, acting between individuals. That the influence of modern conditions is drastically weakening selection of this more comprehensive kind, at least insofar as it applies to physical fitness, is well illustrated by the very small proportion of babies born in the United States who for any reason, genetic *or* environmental, fail to reach maturity. For this proportion is to be contrasted with an estimated twenty percent or

more, who carry not merely the load of physically detrimental mutant genes representative of what their parents had had (as anyone does), but a newly arisen one as well. It is highly unlikely that there is a compensatory increase in the genetic selection that operates via the number of offspring an individual gives rise to. Since the dying off of such genetic defects seems, in the light of this and other evidence, to be taking place at a rate so much lower than that at which they are arising anew, it would follow that they are accumulating over the generations. This is of course a result not only of our improved medical techniques but also of our many other potent modern ways of helping individuals who have physical shortcomings.

It is to be observed that this abundant rendering of social aid to the infirm, although so notable an achievement, does constitute a load on society, and that if society continues to put forth all possible efforts to furnish it, while those aided continue to multiply as at present, this social load will inevitably increase as mutant genes accumulate, until a weight of it is neared so great that its further increase simply could not be borne. For, by that time, practically all of society's available energy will be consumed in counteracting the vast accumulation of genetic impairments carried by everyone. Nevertheless, people will again be dying off from their disabilities at the same rate as they did under primitive conditions, provided that the rate at which new genetic defects arise is about the same as ever, as we would have every reason to expect for such a society.

Similar considerations, but perhaps even stronger ones, apply to the effect of modern conditions on the differential multiplication of genes that underlie psychological traits. For, as social aid becomes more effective, a lower-than-average native intelligence becomes ever less of a hindrance in surviving and having children, and so does a lower-than-average endowment of genes conducive to mutual aid and to socially useful behavior in general. In fact, under present conditions, failings of these kinds are likely to result in the production of more children than usual, sometimes by way of psychological compensation on the part of the parents, and sometimes as a result of their maladroitness, shortsightedness, irresponsibility, or unscrupulousness. Conversely, those persons who are more highly endowed in these respects tend to limit the size of their families more than most persons do, in order to enable both their offspring and themselves to live a better life in many other respects. In consequence, the very traits most significant for mankind, especially in a civilization at a high level of technology, must tend to slide downhill in their genetic basis.

What element in our cultural attitudes must we regard as lying at the root of this evil? Is it not clear that the principle of the equal sacredness of every living being, if it could have been applied from the beginning, would never have permitted organisms any biological or other progress, but only all-round deterioration? Similarly, that principle, when applied indiscriminately to the life and reproduction of human beings, is ultimately incompatible not only with their progress but even with their survival. Nevertheless, culture made an enormous advance in promoting the extension of aid to the weak and ailing and, in general, in fostering reciprocal re-enforcement. For, in order to elicit men's best efforts in behalf of society, as well as to serve them best individually, it is essential for everyone who has the faculties of self-awareness and sociality, with their associated desires for self-preservation and the preservation of others, to be secure in the realization that society on its side will promote his life and well-being, subject only to a reasonable, accepted degree of risk, and short of highly unusual circumstances that might demand of him the supreme sacrifice for the common good. Few responsible persons would wish this privilege of living to be revocable for anyone possessed of these fundamental human attributes, although they would not necessarily extend the principle to cases in which consciousness and regard for the self and others had not been attained or had been permanently lost. However—and here lies the crux of the matter—this obligation on the part of society to conserve the lives of all its *de facto* members should by no means be construed as including the proposition that everyone's *germinal* material should multiply *ad libitum*, or even at the same rate. For in this area the interests of the future generations themselves should be recognized as being the overriding ones.

At this juncture, where our modern culture has drastically interfered with our genetic progress and even our genetic maintenance, our ever more powerful but more dangerous and tricky techniques, and the growing complexities of our social, biological and physical problems, are demanding an actual enhancement rather than a deterioration of our native intelligence and its supporting faculties, as well as of our genetic substratum for cooperative behavior. For now as never before ample checks and balances and wide participation are needed in arriving at the decisions that guide society in general, in order that these may be aimed at promoting the common interests of all mankind, and founded on the widest foresight and scientific judgment, derived from all fields. And although this requirement automatically rules out dictatorships and authoritarianism, the methods of democracy can hardly succeed in meeting it indefinitely either, as the problems grow more difficult, unless the people at large also grow in their capability of duly understanding the issues, and of being strongly motivated to serve humanity everywhere. For the pitfalls and the lures are in every generation growing more deadly in their potentialities for our entire society, even while the same factors are also offering us the possibility of ever more prodigal bounties.

Moreover, even if physical disaster and misery could be staved off for a long time, could we be content to see our species become a vast mass of contented cattle, perhaps well fed and ably manipulated by a relatively small intelligentsia and power elite, but a mass who went through their prescribed motions without realization of the nature of the operations they were engaging in or the scheme of things in general? Are the cultivation of algae and the exploration of other worlds only to constitute a monstrous program of bread and circuses for unthinking mobs? If so, it is to be hoped that in our future wanderings in space we will come upon a form of life or mechanism that embodies a higher

combination of realism and idealism than ours. Perhaps this encounter will bring us to our senses in time, but more probably it will be too late.

Man's Future Birthright

However, it can be maintained that this picture is too black. For we do have at least the germs of that understanding and unselfishness by which we could overcome our increased difficulties and press forward more wisely. But the only road to success in this attempt is to make increasing use of socially based intelligence and intelligently guided social drives, now that the automatic rectification of neither our cultural nor our genetic missteps can be counted on any longer. We must therefore accept it as among our prime tasks to use what common sense and good will we have to increase that common sense and good will by all means available, educational, psychological, physiological, economic, political, and, yes, genetic.

One group of measures of a genetic kind that it should be relatively easy to put into effect today is the better protection of our germinal material from the mutagenic influence of radiation. Some organizations of medical men have at long last taken steps to improve medical practices in this respect, and both national and international committees have set up improved standards of protection against the radiation emitted in peacetime by radioactive materials of artificial origin. Yet, as the circumstances in which people may be exposed to significant amounts of radiation multiply, the problem increases.

In diverse ways, as through accidents with reactors or other nuclear devices, through carelessly conducted laboratory operations utilizing radioisotopes or particle accelerators, through sometimes inadequately controlled disposal of our mounting masses of atomic wastes, not to speak of fallout from tests, the so-called emergency exposures are increasing, especially among the personnel engaged in such work. In addition, preparations are afoot for the intensive development of commercial flight at such high altitudes as to make it likely that the crews and even the passengers and perhaps, in the over-all average, the general public itself will receive, from cosmic and solar sources alone, more ionizing radiation than is now taken to be a permissible total. Add to this the fact that according to some influentially sponsored plans for wartime radiation emergencies, wherein civilians would be assigned in large numbers to activities and locations that entailed their receiving as much radiation as the maximum now permitted for the occasional worker operating under a peacetime emergency, there will be a deliberate disregard, in the making of these civilian assignments, of so "impractical" a consideration as the preferential sparing of persons who are in the age category of parents-to-be.

In view of this situation, individuals and organizations having a realization of this generation's responsibility toward its children and descendants should insist on the adoption of two basic measures. The first is the assignment of a highly preferred position in regard to radiation protection to the younger two-thirds of the population, those still likely to reproduce. The second is the establishment, at least for all men of reproductive age who are subject to more than ordinary radiation hazards, of banks of their germ cells, stored in deep-frozen condition well below ground level. As a starter, this facility should be made available to all those in the armed forces, those engaged in any work involving artificially produced radiation, and those participating in high-altitude flights or space flights. By this means, moreover, not only mutations induced by radiation but also those resulting from artificial chemical mutagens and even from the spontaneous processes of ordinary ageing would be largely avoided. In fact, even in cases of military or civilian reproductive incapacitation or outright mortality a child, if it were desired, could still be fathered.

More research is urgently needed along these lines to explore possible methods of extending such techniques to female germ cells, following up J. K. Sherman's work with mice three years ago. A related task of great importance is the working out of techniques for effecting the multiplication and maturation of immature germ cells *in vitro*, since this would allow a minimal supply of them, maintained in the deep-frozen condition, to continue to provide any specified quantities of the mature cells. It is to be hoped that those for whose children such services would be helpful will soon create a demand for them.

However, a diminution in the artificial induction of mutations serves only to reduce the rate of genetic deterioration. Still larger problems confront us if we would adequately prevent deterioration and even bring about genetic improvement. In this connection it may be admitted that we can hardly expect enough good sense and good will to be functioning in our society today to lead people in significant numbers to appraise their own genetic worth realistically, and then to proportionate the number of children they engender to this estimate. Nor can we expect a democratic society to impose on itself discriminatory laws or social arrangements whereby persons of presumably greater genetic worth would find that the circumstances associated with the kinds of positions that they tended to choose were especially conducive to having children, while those less well endowed were subtly tempted, as a result of the kinds of careers open to them, to restrict the size of their families. Such methods, although long advocated by the safe-and-sane eugenists of the Galton school, are too conservative to be practical.

Nevertheless, human nature does already have the steel that can set going a spark of idealism, especially if the flint of self-interest can be struck as a means of kindling it. For it will not be long before people become more generally aware that modern techniques make it physically possible for them to have in their family one or more children derived, at least on one side, from the germinal material of outstanding personifications of their own ideals. Preferably, these adopted ancestors will have been deceased for decades, and will have become recognized in the perspective of time as having exemplified, first of all, the generally admired primary virtues of high character, keen all-round intelligence and sound physique, and secondly, when desired, one or more particular gifts or traits especially cherished by the adopting couple—such, for instance, as heartfelt lovingkindness, a joyful disposi-

tion, musical proclivities, aptness at repartee, rapid calculation, courage, or endurance.

Surely, on becoming fully aware of this opportunity, many of the more idealistic couples, especially those among them who are afflicted with sterility or a dubious genetic endowment, but also many others who earnestly desire to participate, will freely elect to generate and rear as their own one or more of these children derived from germinal material of their choosing. They will do so openly and proudly, not in the clandestine manner that physicians now insist on. Then, as the success of this practice of germinal choice becomes manifest, an ever larger portion of the community, desirous of similar benefits, will take up the example and will tend to follow the patterns of choice set by the high-minded vanguard. Therewith, the first step will have been taken on the long road of consciously guided genetic progress, the road that man's own innate intelligence and social disposition, brought to a higher level by his scientific culture, has opened up to him alone.

In this field as in others dictation, whether by politicians, physicians, or geneticists, would tend to be self-defeating. Moreover, self-respecting couples in a democratic society will not much longer tolerate the present practice of having the decisions in a matter concerning them so intimately made for them *ex cathedra* by others, while they are even kept in ignorance of what the choices were. On the other hand, most persons voluntarily assuming so significant a responsibility would themselves desire to make their choices in the light of ample information and advice, from diverse relevant sources. And they would welcome such assistance the more, the greater the wealth of germinal material that was open to their choice.

From this type of self-determination there will issue a salutary genetic diversity that tends to raise humanity to an ever higher level. For, as the practice continues, new and ever better combinations will be brought into being, and it will become possible to profit increasingly by the experiences gained in earlier trials, in consequence of their having been conducted openly. Finally, it will become difficult to understand why people should have been so long in coming to the realization of the extraordinary opportunities that this course opened to them immediately, as individuals, and also in the long term, as a species. Here is the inevitable path of multiplicative survival for a human-kind both rational and social.

However, just as most of the elite in societies based on slavery, feudalism, or a caste system believed that the existence of masses of underlings was necessary and justified for the support of their own supposedly high level of culture, so it is sometimes maintained today that we need people who are satisfied to be the hewers of wood and drawers of water of the machine technology that is devised and directed by our intellectuals and executives. These standpatters overlook the historic lessons that show the greater ultimate strength of societies whose commoners were accorded more opportunities for individual development and self-determination. They fail to see that it was this very condition which lay at the root of the rise of science and the creativity of modern culture, whereby in turn people's richness of life and potentialities of accomplishment, both as individuals and as groups, became so enormously augmented. Enhance the intelligence and the sociality of individuals in general by whatever means, through their education, mode of organization, or genetics, but preferably by all means together, and they will themselves in time devise better ways, and more effective artifices, for accomplishing the routine and the dirty work, thereby freeing themselves to engage in ever more creative, interesting and congenial activities. Moreover, as they will also come to realize, genetics must ultimately form a part of this recipe, if their success is to persist.

Such a society will be one whose cultural and genetic changes progressively re-enforce one another instead of, as today, acting in contradiction. Its members will not need to feel ashamed of their unworthiness in engaging in so responsible and portentous an enterprise as that of venturing off the planet that has so long nurtured them, and extending their existence into cosmic reaches. As architects of the inner worlds of themselves, they will strive to fashion themselves into fitting agents of a fully conscious survival through multiplication, one activated by understanding and mutual creativity, and continuing on to spheres and modes of existence that we of today cannot conceive.

FUTURE AIBS MEETING SITES

1962—Oregon State College, Corvallis
August 26-31

1963—University of Massachusetts, Amherst
August 28-31

1964—University of Colorado, Boulder

A chemist stimulates scientists and newspaper men alike in a talk given at a Conference on Science Information.

W. F. Libby

University of California, Los Angeles

Atomic Science

EDITOR'S NOTE: *At a Conference on Science Information, sponsored by the American Institute of Biological Sciences and the Council for Advancement of Science Writing, held in Princeton, New Jersey, March 5-7, 1961, Dr. W. F. Libby, 1960 Nobel Laureate in Chemistry, spoke. Dr. Libby, Professor of Chemistry at the University of California at Los Angeles, and former member of the Atomic Energy Commission, also departed from his text to set forth how the process of radioactive dating is revising previous chronologies in archeology, and how his own interests have contributed to this. After his lecture, for 90 minutes he answered questions posed by managing editors and scientists. When the evening finally came to a close, a scientist from another discipline commented: "It is too bad that scientists can't always have laymen in their audience when they explain technical matters: maybe then other scientists would be able to understand them, also." Dr. Libby's basic text is presented here, both for the clarity of his presentation of historical material, and for his provocative suggestion for closer scientist-press ties.*

THE ATOM is our substance. Atomic Science is our understanding of matter. You all know a little of its structure—a kind of solar system in which the planetary electrons constitute most of the spatial character and the tiny heavy suns constitute our mass. Until a few years ago our only direct contact with the atomic suns was on the bathroom scale, and even then it was not realized that this was so. Our main substance is electrons which weigh very little, spinning around our tiny and inconceivably dense—10^6 tons per cubic inch—atomic suns which we call atomic nuclei.

As you probably know, the fundamental science of matter has now moved into the atomic nucleus, and we seek with giant machines and great efforts to understand its constitution. Tonight I want to tell you of Atomic Science in the sense of the whole atom, including the nucleus.

It all began long ago with the discovery of X rays, which lead to a search for substances which naturally emit X rays and do not require an X ray machine to make them. This search was rewarded in 1896 by the discovery that the heaviest elements Uranium and Thorium do indeed emit rays which we now call gamma rays and are very similar to X rays. Following this, Madame Curie and Lord Rutherford discovered that *radioactivity*—as it had come to be called—was due in large part not to Uranium and Thorium themselves but to the products they made by transmutation of the elements to form new elements like Radium—some of which are atoms of shorter life time (1600 years in the case of Radium)—which were constantly resupplied by the parent Uranium and Thorium whose lives are billions of years long.

At this point in 1912, the planetary structure of the Atom was found, and the first theory of the atomic electrons was formulated by Bohr in 1913. The Principle of Isotopes and the Law of Radioactive Dating were found at the same time. The Principle of Isotopes is that different nuclei can be tied to a given planetary system. For example, if there is only one electron going around the atom, it is hydrogen; while if there are 90, it is Thorium. Now for H, there are three different nuclear suns different in their masses and weighing 1, 2, and 3 if the lightest be taken as being of unit weight. The heaviest in addition is radioactive. The three Hydrogen atoms are called Protium, Deuterium, and Tritium; and thus, water which consists of 2 hydrogen atoms tied to one oxygen atom has three different forms—ordinary protium water, deuterium (heavy) water, and tritium (radioactive) water (and a number of mixed forms in addition). So, it is possible by measuring the density of water and putting it in a Geiger Counter to measure its radioactivity to determine its isotopic composition. Ordinary rainwater at the present time consists of about 1/5600 D and $1/10^{17}$ T, with the rest H. Now the Principle of Isotopes is general. Isotopic people exist in that we consist of C and H, both

of which have radioactive isotopes, and many useful and important applications of Atomic Science have been made and will be made in the future by Isotopes. The Atomic Energy development has supplied us with great quantities of them, and they now constitute the principle immediate Peaceful Use of the Atom.

The third great discovery racked up by 1912—the Principle of Radioactive Dating—is that the radioactive atom is an absolute and ideal time clock, running along at an immutable rate and readable by the amount of product made; the basic point being the complete isolation of the nuclear world from our ordinary electronic world. Radioactivity is a nuclear transformation in which the atomic nucleus itself changes, and the nuclear forces are enormous as compared to the ordinary electronic forces so the rate at which Uranium changes into Pb is completely unaffected by changing the Uranium from the metal form to a compound used to color pots yellow. Therefore, the half life U^{238}, 4.5 billion years, is immutable; and when we find the amount of Pb or He in old rocks or meteorites (these are the products of U^{238} activity), we can calculate the time elapsed since the rocks congealed. In this way, we know how old our part of the Cosmos is—4.5 b.y. Other clocks are U^{235} 0.7 b.y., Th^{232} 1.3 b.y., Rb^{87} 50 b.y., K^{40} 1.3 b.y., Re^{187} 50 b.y. All give the same answer.

After these three great achievements, Atomic Structure, Isotopes, and Time Clocks, not much more happened for about 20 years except further elaboration and development of these great principles. Then in 1932 things broke loose again, and our country was in the center of it.

The schedule was and is:

Neutron discovered	1932
Artificial Radioactivity discovered	1934
Nuclear Fission discovered	1938
Atomic reactor	1942
Atomic Bomb	1945
Isotopes	1912, Now & Future
Atomic Power	1958
Sherwood (Taming of the H-bomb)	Future
Plowshare (Peaceful Uses of Atomic Explosives)	Future
Space Propulsion	Future

Conclusion

The atom is our substance, our life, and the understanding of her is tantamount to knowing our way in the dark wilderness in which we are born. Atomic Science is our hope, and newspapermen have no more serious responsibility than to inform the readers as best they can on scientific fact (not fancy) as it appears. For example, the other day a story appeared from the Bell Telephone Laboratory, which probably will rank with the great developments of 1961—the story said that a tiny wire cooled to low temperature had conducted electricity at a current density of 100,000 amperes per square centimeter in the presence of a magnetic field of 88,000 gauss with no resistance loss; i.e., no heating. Why is this important? Well, it may greatly help to make space travel practical (retaining plasma for ionic propulsion), to tame the H-bomb for power, and to build machines for studying the atomic nucleus itself, as well as all the things as yet uninvented. Why did this story not appear in some of the great dailies? It appeared in the weeklies, but in only a few dailies, such as the N. Y. Times. Well, this is our problem. I would suggest that each of you keep contact with an opposite partner in science and that you set up a system of correspondence to keep informed, thus making science available to the newspapers. In December in Stockholm I visited the laboratory of the great Norwegian chemist Berzelius and found his letters filling many volumes. In his days even scientific journalism was a flop, so private correspondence was the only answer. And my suggestion is that you set up a similar system, so the Managing Editor of the Buffalo Evening News, or the Los Angeles Times receives monthly a letter of information from a practicing scientist on what is really new.

Concluding finally, let's recognize Atomic Science for what it is—the future, the undiscovered land, the world without end, the modern western seas. Let us tell the youngsters that to be a scientist privileged to discover the unknown is comparable to being a medieval architect of the great cathedrals. By building for the future and doing humble tasks such as laying bricks and mortar, or working in Switzerland or in Long Island on the only two great nuclear telescopes now existent for nuclear studies, we come to our proper place in the scheme of things as man, king of the world and aspirant to the universe.

ATTENTION All Prospective Employers of Biologists and Agriculturalists . . .

The November 1961 Placement Directory is currently available. Resumés of approximately 135 biologists, their professional qualifications, training and experience appear in the November Placement publication. Cost per copy $2.00. Direct request to the AIBS Office.

Tracy M. Sonneborn
Indiana University, Bloomington

Report to AIBS Governing Board[1]

THE AIBS, unlike other professional biological societies, is primarily concerned with activities important for *all* of biology and for biologists *in general.* To this end, the Governing Board, the meeting of which we now open, is composed of representatives of each of our numerous member societies. This Board devotes one of its two meetings each year, the one held at the time of the AIBS Annual Meeting, to a broad review of the operations of the Institute during the preceding 12 months. Some years ago the Board decided that this annual review of operations should be thrown open to the examination and discussion of a wider representation of the biological public which the AIBS aims to serve. For this purpose, we have invited to this meeting representatives of our Affiliate Societies; representatives of agencies that have a financial stake in our operations; representatives of the biological divisions of other organizations; the Presidents of Biological Societies; and other friends of AIBS or people who may have an interest in these proceedings. Let me then extend to our Board and to all of our guest-observers a warm welcome and a sincere and urgent invitation to you to participate in the questioning of the reporters and in the discussion of the reports now to be presented.

It is my duty, privilege and pleasure to present now the report of the President of AIBS. As you will see, my report and Hiden's will reflect the contrast between the young novice and the old experienced hand. I—the old man—am of course really the young novice. So much so that I must begin the President's report by seeking cover with the contention that it is something of a miracle if I have anything at all to report. I can't tell you a thing that the President did during the first third of the last 12 months—because I wasn't the President yet. Jim Dickson was President then. He is in Hawaii now. As things are presently organized, even if he were here, he wouldn't have an opportunity to tell you about what he did during that first third of the past year. During the second 4 months, my first 4 months in office, your new President sat in on a few major committee meetings, and then, in April, he came full of ignorance and enthusiasm to his first meetings with the Executive Committee and the Governing Board. That was really his first opportunity to exercise leadership, but, alas, he found so many urgent items on the Agenda that he could only make a small beginning to unfold his program. Four more months went by—with, of course, more committee meetings—before his next opportunity came, the second and final meetings of the Executive Committee and Governing Board at our present Annual August AIBS meeting. But time for new action here is short. This is our open review meeting. And his reporting year of 8 months has ended. He might well be looked upon as a frustrated organization man.

I have drawn—indeed I trust you suspect—have overdrawn and caricaturized the roles of the President, the Executive Committee, and the Governing Board in AIBS affairs in order to emphasize the elements of truth and to stress the need for reformation. In extenuation be it said that my situation as President was unique. No other President had come to the office without previous connection with the councils of AIBS. Other Presidents have had a second year of office, during which their experience doubtless bore more fruit. The members of the Executive Committee and Governing Board serve longer terms. Nevertheless, reformation of the system soon assumed in my mind the proportions of a major necessity. I felt that this would be required in order to realize the basic potential strength of the AIBS.

The AIBS is democracy. *That* is its basic potential strength. Legal responsibility lies fully and completely in this Governing Board assembled here today. The Board may and must delegate limited powers to individuals and groups, to the Executive Director and Committees; but it retains the right to dismiss these individuals and to instruct these groups. It elects its officers, including the President, who can initiate not action, but only suggestions for action.

As I began to become acquainted with how this noble design for a representative democracy of biological societies was working out, I had to conclude that—how-

[1] An address delivered at the 1961 AIBS Meetings at Lafayette, Indiana. The author is President of AIBS.

ever well the Institute was working, and it was in my opinion working marvellously well—nevertheless it was a representative democracy to but a relatively slight degree. The President could easily be but a figurehead, a front. The Governing Board could spend most of its time doing little more than OK'ing. The channels of communication between Societies and their representatives on the Governing Board were often cut or ineffectual. No wonder therefore that the AIBS came to be looked upon by many *not* as a representative democracy, but as a monolithic bureaucracy.

Again let me insist that even if my exaggerations were literal truth, two important facts remain: 1) the AIBS was *performing* magnificently; and 2) the Executive Director was not only fully aware of the defects in working out of the democratic objectives, but was anxious to remedy the defects. In fact, last April he brought the general problem to the attention of the Officers, the Executive Committee, and the Governing Board. By that time, as I said, I was already well aware of the problem myself and had made up my mind to go to the Executive Committee and the Governing Board with a number of proposals designed to recapture and revitalize the original conception of AIBS: to increase the effectiveness of the Officers, Executive Committee and Governing Board; to enlist more active participation of our Societies and their members in AIBS work; to strengthen and improve relations with like-purposed institutions, organizations and agencies; to draw upon the ablest available biologists for service; to assure turn-over in, and infusion of new blood into, our committee work; and to encourage attention to the long-range needs for AIBS activity. That has been my program. Let me now tell you how it has fared.

Thus far, my proposals have been received with enthusiasm by the Executive Director, the Executive Committee and the Governing Board. They have indorsed them and Hiden Cox and I have been busy activating them. Yesterday, the Executive Committee agreed to hold an extra meeting in November in order to take up the remainder of my program.

Reforming the Organizational System

I shall now outline for you briefly the three main lines of action for reforming the organizational system which were approved at our one previous meeting (in April). This will include also proposals originating from the Executive Director, the Executive Committee, and the Governing Board.

First line of action: To facilitate training for leadership by the succession of Presidents. Future Presidents of AIBS will have one year of in-service training as Vice-President. During the year the Vice-President is to have ex-officio status on all committees and is to work closely with the President and the Executive Director. This limits the President's term to one year; but that *one* should become more effective with no loss of time in learning the job.

I have further asked the six previous Presidents of AIBS to supply a corpus of background for new Presidents by writing an account of whatever they think would be of value to their successors. I shall do the same. One copy of these presidential pearls will be in the hands of the current President, one in the hands of the current Vice-President. There will be a foreword requesting each new President to continue the tradition and pass his copy along to the newly-elected Vice-President.

Second line of action: To strengthen the Governing Board and its representation of member Societies. With the backing of the Governing Board, I initiated the practice of phoning the President of each Society whose representative's term is due to expire this year. In these conversations, I emphasize to each President the importance (a) of sending us a strong representative, (b) of obtaining assurances in advance that the person selected will attend meetings or send a qualified alternate, (c) of making the representative a regular or ex-officio member of his Society's Executive Committee, (d) of assuring that the Governing Board member's report on AIBS will be brought to the attention of his Society at its annual meeting and in its published proceedings; (e) of including in the annual call for papers *a call for suggestions or comments about AIBS* to be transmitted via the representative to the Governing Board; and (f) of instructing its representative about items the Society wishes to have brought to the Governing Board.

These conversations with the Society Presidents have been warmly received. I hope they will achieve their purpose. I should also add that some of our Societies needed no prodding on these matters. This we knew. To their Presidents I expressed our appreciation.

On the other side of the coin, the Governing Board has agreed to accept new duties. First, it will examine in depth each year at its Spring meeting one of the major activities of AIBS. It will begin this next April with a study of our extensive educational program. Second, the Governing Board has agreed to distribute itself, ex-officio or otherwise, to the various AIBS committees, so that each Governing Board member will have a firsthand working knowledge of some part of the AIBS activities and can serve as an authority on it to assist the deliberations of the Governing Board. I shall present in November still further plans with the same objective of developing the governing duty of the Governing Board.

Third line of action: To broaden participation in AIBS activities. Although some 800 biologists are now engaged in AIBS work, this is only 1% of our biological manpower resources. We want more and are determined to get more. We have made a start in this direction by requiring annual turnover of 1/3 of each committee with immediate reappointment prohibited. We are also requesting each Society and the chairman of each biological department in our colleges and universities to provide us with lists of potentially good committee workers. From these lists, if we can get them, we plan to bring into our work much fresh blood and at the same time give our Societies a larger role in AIBS work—an objective we consider of vital importance.

I conclude this account of our progress in bringing Officers, Board, Member Societies and biologists in general into more effective participation in our work by mentioning a sly move of our Executive Director.

Taking advantage of my ignorance of the past, he informed me that I was to make a report to you. Until yesterday, I did not know that I am the first President to do this.

The Annual AIBS Meeting

Before passing to our new long-range activities, let me say a few words about one other matter: The Annual AIBS meeting. As it gets larger and larger, it is more and more difficult for a person to get to hear what he wants to hear in the multiple simultaneous sections. Some years ago, it was Dr. Went I believe who mentioned the possibility of publishing in the AIBS Bulletin a series of resumes of the main contributions presented at the meeting. The Governing Board instructed me to see what could be done about this. A committee of rapporteurs for this meeting has been set up to make a trial of it and to make recommendations for the future. We shall see what comes out of it.

A special concern of AIBS is the nature of the program for the AIBS evening. Like many others, I have not been happy at the amount of time and attention given—to mince no words—to selling AIBS. Nor have I been happy at the custom of featuring an address by the retiring President, which often takes the form of further selling AIBS. (Parenthetically, you will hardly accuse me of being solely or largely guided by reluctance to make a speech, after what you are now sitting through!) The Governing Board concurred in these views and instructed the Director and me to seek out a top speaker to address us on a timely subject. We did: the result was Muller on Survival. We were instructed further to arrange for planning ahead, for laying down policy and specifics for future meetings. This is now being done.

Long-Range Activities

Now I come to four actions which have been taken to direct our sights to the long-range needs of AIBS.

(1) We recognized the great potential value of establishing working relations with Zoos, Botanical Gardens, Museums, State Academies of Science, and the like. For example, these organizations could play a role as outlets for AIBS pamphlets and brochures, e.g. on careers in biology, for they would reach a large portion of the public we wish to reach. So steps are being taken to establish these lines of communication.

(2) We have long been aware of the great stake of biology in federal and state legislation. On the other hand, AIBS has considered whether it should jeopardize its tax-exempt status by running the risk of becoming viewed a lobbying organization. A committee has been set up to look into this problem. On that basis further action will be considered. I need hardly remind you of the importance of pending legislation against vivisection and requiring in effect licencing and inspection of animal rooms. Annually, the Congress, of course, decides on budget appropriations for agencies that support biological activities. There are numerous congressional committees before which biologists should testify. There is now in committee a Civil Service bill which provides for increases in salary of scientists, but leaves biologists out.

AIBS, largely through the initiative of its Executive Director, has already played its part in all of these legislative affairs. The facts have been presented to people who were in a position to express their views to the key Congressmen involved. In this way AIBS, among others, has aided in the restoration of budgetary cuts for certain Federal granting agencies. Lists of names of biologists who were qualified to testify have been given to congressional committees. Critical, but overlooked, information has been supplied by AIBS to the authors of relevant bills. The services already accomplished in these ways for biologists by our Director do not appear in our reports, but they are great and deserve to be known.

Nevertheless, we ask whether more, much more, should be done. And this question, with our sights towards the future, has been posed for our committee to deliberate upon and to come up with specific recommendations. Our moves for attacking the problems of legislative action and their administrative interpretation at both the Federal and State levels may well become of far-reaching importance.

(3) A third and complicated area for long-range consideration is the impact of federal funds upon biology and biologists. The growth of Federal granting agencies since World War II is one of the major facts of life for biologists. Before that time, the great endowed Foundations played a similar role, but of course on a much more limited scale.

Both then and now, biology prospered as a beneficiary of these bounties. And on both occasions problems inevitably arose as a result of the necessarily powerful influence being wielded. Because of the grant scale and varied types of support from Federal Agencies, the problems are multiplied. A most thoughtful, constructive, and—I believe—wise confrontation of these problems has been set forth recently by Warren Weaver in his essay "A Great Age for Science" which is worthy of careful study both by biologists and by the administrators of Federal funds.

I do not propose to enumerate here the many problems involved. But I do wish to mention, merely as one example, the problem of where the granting agencies' duties end. Obviously, at the end of a grant, they must review its accomplishments in order to decide whether to renew. But what are their duties, if any, during the progress of a grant? Here a quotation from a statement issued on November 15, 1960, by the President's Science Advisory Board is appropriate: "Once support is granted, the Federal Government should not seek to supervise technical operations directly." This principle was followed by the Rockefeller Foundation and, in so far as I am aware, is followed by Federal granting agencies in regard to research grants. They do not observe, inspect, advise or inquire further after a research grant is made until it terminates. The same ruling does not appear to be followed, however, in some other types of grants. And the question may at least be fairly raised as to the wisdom of departing from that rule in *any* type of grant.

There are, however, many more problems. A recent report by one of the Program Directors in a Federal

granting agency has forcefully and sharply put the finger on some of them. Our Executive Committee and Governing Board have considered others, such as preferred areas of support, gaps in areas supported, and their insidious influence in diverting the proper interests of researchers into channels attractive to a granting agency. The whole set of problems is of such great importance to the future of biology, as well as of other sciences, that it is high time the situation be explored, brought out into the light, and be subjected to free discussion and criticism. The Governing Board therefore instructed me to appoint a committee to do this. We are enlisting for this purpose a group of outstanding individuals whose competence and stature will command a wide hearing for their report and, we hope, eventually lead to the formation and activation of wise policies.

(4) Our fourth and final action in regard to long-range needs for AIBS is particularly close to my heart. During the years when AIBS was getting on its feet, it was busy justifying its existence and warranting its support by biologists. It had little time or opportunity to sit back and think far ahead into the future. Now that AIBS is firmly established and smoothly running, with more than enough in progress to engage its full attention and energy, it can, should, and must shift its sights from the immediately urgent to the long-range far-sighted needs of biology and biologists. This will of course come more and more to be the concern of the Officers and Board members, of the Director and his staff, in the years ahead. But it seemed to me also that AIBS could greatly profit by enlisting for this service more of the top brains and imaginations available. I therefore asked, and was granted by the Governing Board, authority to appoint a Long-Range Planning Council whose charge would be to dream and not worry about questions of the practicality or realizability of their dreams. This Council, as I am setting it up, will be free and unformalized. Its minority reports —even minorities of one—will be sought and cherished. I am asking the members of it to look ahead 5, 10, 20 years and tell us what they think should be. Their reports will come to the Officers and Governing Board whose job it will be to try to weed out the nightmares and make the dreams come true.

I have proceeded very slowly and deliberately in tapping people for this Council. I want to make no mistakes because I believe it will, as much as anything can, establish the highest quality of activity in AIBS. I'd like—if I can find sufficiently imaginative people—to have representatives of the major kinds of biological fields, especially of those which appear to pose great opportunities for the future, such as molecular biology, genetics, population biology, micro-instrumentation, tropical, arctic, and ocean biology, etc. I have not yet assembled the full Council. But I can say two things about it: first, no one has yet refused to serve, all have accepted with enthusiasm; second, among those already tapped are the most outstanding biologists in America.

Conclusion

I close with the boast I made at the start. In spite of my initial ignorance, the miracle of accomplishing at least something has occurred. To be sure this is due in large measure to the gentle guidance and unfailing assistance of Dr. Cox and his staff and to the cooperative activity of the Executive Committee and Governing Board and their committees. As a result, AIBS will now have trained and able Presidents, Governing Boards that represent and govern, member Societies that actively participate and will be prouder and prouder of their part in the AIBS, increasingly strong and cooperative relations with other organizations, and a number of far-reaching new enterprises, among which is one that should yield the most imaginative and far-sighted plan of future activities that the best brains and imaginations in biology can dream up for us.

THE WILDLIFE DISEASE ASSOCIATION

announces a

1st International Conference on Wildlife Disease

sponsored by the National Institutes of Health and conducted under the auspices of the American Institute of Biological Sciences

The conference will be held on June 25-27, 1962 at the Sha-wan-ga Lodge, High View, New York.

The program will include papers and discussions on Population Principles, Epizootiology of Animal Parasite Infections, Epizootiology of Viral and Bacterial Infections, Physiology (including stress), Radioecology, Pollutants, Biological Control, and Pathology.

Additional information will be published in forthcoming issues of the AIBS Bulletin.

THE EDITOR'S DESK

The Graduate School of Oceanography, incorporating the Narragansett Marine Laboratory, was established July 1, 1961 at the University of Rhode Island.

The Placement Service of the American Phytopathological Society has names and qualifications of candidates available for employment in plant pathology. The service is free to APS members and available to any employers with vacancies. For further information contact: Phytopathology Placement Service, Crops Research Division, Plant Industry Station, Beltsville, Maryland.

The Special Committee on Oceanographic Research (SCOR) of the International Council of Scientific Unions is sponsoring an International Indian Ocean Expedition to take place within the period 1961-1964. The NAS—NRS Committee on Oceanography has assumed the responsibility of developing and coordinating the U.S. participation in the Expedition. Investigators and students who are interested in participating in some part of the proposed program are requested to contact Dr. John H. Ryther, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.

The Harvard Department of Biology is putting into effect a major revision in its plan for undergraduate study of biology. This change is in recognition of rapid developments in the science of biology and the need to utilize the tools of chemistry, physics, and mathematics in certain types of biological research. Two parallel plans of study have been formulated. The first of these is for students interested in biological approaches to the understanding of organisms—their evolution, environment, function, and behavior. The second plan of study represents a break with the past in that it allows as few as two full courses in biology. Students electing this plan will therefore be able to obtain a broad background in the allied sciences of physics, chemistry and mathematics. Under both of the plans, candidates for "honors" will work on a research problem and prepare a thesis, usually during their senior year.

Appreciating the need for strengthening biochemistry as a discipline in this era of rapid scientific progress, Princeton University has inaugurated a broad **Program in the Biochemical Sciences.** The new program, announced by President Robert F. Goheen, will be directed by Professor Arthur B. Pardee, who joined the Princeton Faculty this fall.

The University of Nigeria opened its doors to students in September, 1960. Science courses started September, 1961. The caliber of the biology courses will be seriously jeopardized unless equipment and library facilities can be developed rapidly. This is an appeal for donations to anyone who has unwanted back numbers of any biological journal that would provide useful reference material for under graduate students or for research projects. Books also, in any phase of biology, would be useful. Supply manufacturers are also invited to send current catalogs. Donors should do one of two things: (a) Ship the material prepaid to: Dr. E. G. Martin, Biological Science Advisor, University of Nigeria, Nsukka, Nigeria, via Government Coastal Agent, Port Harcourt; (b) Send material prepaid or deliver to: Dr. George Axinn, University of Nigeria Project, Michigan State University, East Lansing.

Recently the **American Academy of Microbiology, Inc.,** through its American Board of Microbiology, began to certify competent and qualified scientists in Public Health and Medical Laboratory Microbiology. This program is being received with considerable interest. In accordance with a previously established schedule, the American Board of Microbiology is now ready to accept applications from competent and qualified scientists in additional areas. These are: Public Health and Medical Laboratory Bacteriology, Public Health and Medical Laboratory Virology, and Public Health and Medical Mycology. Applications will also be received for certification in Public Health and Medical Laboratory Immunology although actual certification in this area will be slightly delayed. Additional information may be obtained from the Secretary, American Board of Microbiology, 232 Burrill Hall, University of Illinois, Urbana.

An Institute of Radiation Ecology has been established at the University of Georgia for the purpose of coordinating and extending the regional ecological program which has been developing during the past ten years on the campus of the University, at the Savannah River Plant, and at the Marine Institute at Sapelo. Dr. Eugene P. Odum will serve as the Director of the new Institute which will have headquarters in the new 13 million dollar Science Center at Athens, while Dr. Frank P. Golley has been appointed Resident Director of The University of Georgia facilities at the Savannah River Plant located at Aiken, South Carolina. A permanent laboratory building to replace the present field quarters is being provided to increase the effectiveness of the field research on the 250,000 acre Savannah River reservation.

The Public Health Service, through its Division of Water Supply and Pollution Control, will conduct the related, 1-week training courses, **Radioactive Pollutants in Water,** November 6-10, and **Radionuclides in Water,** November 13-17, 1961, at Cincinnati, Ohio. Trainees may register in the single or related courses. Full descriptions are given in the *Training Program Bulletin* which is available on request. Applications, or requests for information, should be addressed to the Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio, or to a PHS Regional Office.

The National Aeronautics and Space Administration announces the availability of 2 staff positions in its Life Sciences Programs. Each is at the GS-15 level which offers a salary range of $13,730 to $15,030 per year. The first vacancy is for a microbial biochemist who is "interested in biochemical origins of life, evolution, and related problems such as extraterrestrial life." The second is for an environmental biologist, "preferably with a physical or biophysical background, interested in effects of newly defined space environments—weightlessness and radiation—on biological systems." The function of each of these persons will be "to promote and develop programs of research in these areas." Applications for either position should be directed to Dr. Freeman H. Quimby, Assistant Director for Space Biology, NASA, Washington 25, D.C.

Science education beginning in kindergarten has been proposed as part of a major program to effect improvements in science and mathematics instruction in all grades through junior high school. A report of a study undertaken by the American Association for the Advancement of Science also calls for a coordinated 10-year sequence of science as an important thread of a general education "to equip all persons for life in a scientific and technological society." The study, sponsored by the National Science Foundation, sees the need for "a substantial team effort" of scientists and educators to produce high quality materials for a major improvement in elementary and junior high science teaching.

Grants

Sigma Delta Epsilon announces its first Grant-in-Aid for scientific research by a woman. The 1961 award went to Dr. Joy Burcham Phillips, Associate Professor of Zoology at Drew University, Madison, New Jersey. The grant will be used by Dr. Phillips to study the ability of the pituitary cells of the primordial gland to respond to certain stimuli and to determine when, during their development, they may be induced to alter their normal pattern.

The Charles F. Kettering Foundation has made a three-year grant of $24,000 to the national Academy of Sciences for the use, as needed, of the Committee on Photobiology of the Division of Biology and Agriculture. The grant will be used to support meetings of the Committee, and of small groups to discuss advances in photobiology, and to foster the development of international cooperation and exchange of information in this field.

The U.S. Commissioner of Education, Sterling M. McMurrin, has announced that 1,491 graduate students have been awarded fellowships under terms of Title IV (Graduate Fellowship Program) of the **National Defense Education Act.** The purpose of this program is to increase the number and quality of students preparing for college teaching and to strengthen graduate facilities. The fellows will be studying in 526 new or expanded graduate programs previously approved by the Commissioner at 146 graduate schools. According to Program Activity Report No. IV—3, issued by the U.S. Office of Education, a total of 153 fellowships or 10.2% of the total number have been awarded in the biological sciences. An additional 34 have been awarded in such related fields as experimental, physiological and behavioral psychology. Thus 13% of the total number of fellowships have been awarded in the life sciences. Report No. IV—3 shows that these new programs in the biological sciences will be carried out in 48 institutions of higher education located in 38 states and Puerto Rico. Of these 48 institutions all but three, Johns Hopkins University, Duke University and Vanderbilt University, are controlled by state or local governments. States having no new programs this year in the Biological sciences include Alaska, Arizona, Connecticut, Illinois, Louisiana, New Jersey, New Mexico, New York, Ohio, Virginia, Wisconsin and the District of Columbia.

Increased knowledge of marine biology on the central Eastern Seaboard will be made possible by a **National Science Foundation** grant to Duke University. The $618,276 grant will enable Duke's Marine Laboratory near Beaufort, N.C., to construct a biological oceanographic vessel, one of the first major U.S. research vessels to be designed and built with biological oceanography as its prime function. Students will also receive training in the marine sciences aboard the ship.

The first annual grants to be made from the newly-established Theodore Roosevelt Memorial Fund will help to support three North American wildlife studies—on the grizzly bear, the yellow-legged frogs of the Sierra Nevada, and the small mammals of a recently flooded island in the Mississippi River. Announcement of the grants has been made by Dr. James A. Oliver, Director of **The American Museum of Natural History,** which set up the Fund earlier this year to provide financial assistance to individuals conducting research in any phase of wildlife conservation or related fields of North American natural history.

The Lalor Foundation announced today the program of awards which it is offering for 1962 for research on the fundamental biochemical and physiological mechanisms concerned with fertility and the early stages of reproduction in various forms of life. The objectives are to further the knowledge and understanding of the basic phenomena involved and to extend and develop the possibilities for effective regulation and control. The awards are open to all nationalities. Requests for information and for application forms should be directed to the Lalor Foundation, 4400 Lancaster Pike, Wilmington 5, Delaware. The final date for receipt of executed application forms complete with supporting data is January 15, 1962. Notification of appointment will be on or before March 15.

To encourage research relating to plankton in the Western North Atlantic, the **Lamont Geological Observatory** offers several fellowships for independent studies in this field. These fellowships are open to qualified scientists of any nationality, and include transportation costs from home to Sandy Hook, New Jersey and return, plus a stipend which will be limited ordinarily to $1,500. In addition, necessary supplies and equipment will be furnished. Living quarters are available for rental in nearby towns. Applications and requests for further particulars should be addressed to Director, Sandy Hook Marine Laboratory, P.O. Box 428, Highlands, New Jersey.

The United States is about to launch its largest and most far-reaching season of scientific research in the Antarctic. With the start of the Southern Hemisphere summer in October, close to 200 scientists from more than 25 universities, research institutions, and government agencies will undertake research projects on and around the world's most remote and least-known continent. **The National Science Foundation** today announced the awarding of 53 grants and contracts totaling $4,687,783 in support of Antarctic research. Additional grants yet to be made will bring the total program to about $5,500,000.

The Inter-University Committee on Travel Grants, representing American colleges and universities, wishes to announce that it is soliciting inquiries and applications from graduate students and scholars who wish to spend all or part of the academic year 1962-1963 engaged in study and research in the Soviet Union as participants in the academic exchange between the United States and the U.S.S.R. American citizens under forty years of age are eligible if they are *graduate students, post-doctoral researchers* or *faculty members* at the time of application. *Teachers of the Russian language in secondary schools* are also eligible. Persons from all fields of study are encouraged to apply, provided that they can show reasonable professional and scholarly benefit to be derived from study in the Soviet Union. For further information and applications write to: Stephen Viederman, Deputy Chairman, Inter-University Committee on Travel Grants, 719 Ballantine Hall, Indiana University,

Bloomington, Indiana. Applications must be received no later than December 15, 1961, to be considered for the 1962-1963 exchange.

Notes on Biologists

Dr. Alfred Novak has given up his position as professor of Natural Science at Michigan State University to take over the chairmanship of the Science and Mathematics division of Stephens College, Columbia, Missouri. He is also going to establish a course in Natural Science on the General Education level.

Dr. Howard L. Hamilton, Professor of Zoology and Entomology at Iowa State University, Ames, has been appointed Chairman of the Department of Zoology and Entomology, effective July 1, 1961. He has been acting head during the past year.

Dr. John T. Wilson, a senior officer of the National Science Foundation and a psychologist, has been appointed Special Assistant to Chancellor George Wells Beadle, as of October 1, 1961. The appointment is announced by The University of Chicago.

Dr. Richard H. Pough, one of the nation's leading conservationists, received the Frances K. Hutchinson Medal for service in conservation at a dinner of the Garden Club of America.

Dr. William W. Burr, Jr., has been promoted to the position of Chief of the Medical Research Branch of the U.S. Atomic Energy Commission's Division of Biology and Medicine.

Dr. Lorin W. Roberts, assistant professor of botany at the University of Idaho, has been named a Chevalier de l'Ordre du Mérite Agricole by the French Minister of Agriculture. Dr. Roberts was president of the botany section of the First International Congress of Histochemistry and Cytochemistry, Paris, 1960.

Dr. F. Joachim Weyl has been appointed Deputy Chief and Chief Scientist of the Office of Naval Research. He will replace Dr. Thomas J. Killian who has resigned to accept a position in private industry. Prior to his appointment, Dr. Weyl was Research Director for ONR and the Director for its Naval Analysis Group.

Dr. Monroe Edward Freeman, a distinguished biochemist and expert in research management, has been appointed Director of the Science Information Exchange of The Smithsonian Institution. As of September 1, Dr. Freeman will fill the position made vacant by the resignation of Dr. Stella Deignan, who has held the directorship of the Exchange since 1950 when it was first organized.

Dr. James D. Hardy has been appointed a Fellow of the Foundation and Director of its New Haven Laboratory by the John B. Pierce Foundation. The Corporation of Yale University has also announced his appointment as Professor of Physiology in the Yale School of Medicine. Before coming to New Haven, Dr. Hardy was Professor of Physiology at the University of Pennsylvania and Director of Research at the U.S. Navy Aviation Medical Acceleration Laboratory, Philadelphia.

Dr. Richard R. Willey has been appointed Deputy Chief of the Division of Research Grants, National Institutes of Health, it was announced by Surgeon General Luther L. Terry. Dr. Willey was formerly Chief of the Research Grants Branch, Division of General Medical Sciences, NIH, and was also Executive Secretary of the Mental Health Study Section.

Dr. N. Paul Hudson retired from active duty at The Ohio State University on June 30, 1961 after serving 26 years as Professor and Chairman of the Department of Bacteriology, Dean of the Graduate School, and Assistant Dean of the College of Medicine.

Dr. L. C. Knorr, phytopathologist, University of Florida, has returned to his post at the Citrus Experiment Station, Lake Alfred, Florida, after serving a year in Egypt as Agricultural Officer for the Food and Agriculture Organization of the United Nations. He collaborated with Dr. Farid Nour-Eldin of the Ministry of Agriculture in studying the virus diseases affecting citrus in the United Arab Republic.

Dr. Egbert H. Walker, formerly of Smithsonian Institution, has received, for the second time, the Oberly Memorial Award, given biennially for the best bibliography in the field of agriculture or related sciences. The presentation was made in Cleveland, Ohio on July 10, at the American Library Association Annual Conference, for his work, *A Bibliography of Eastern Asiatic Botany, Supplement I,* published by the American Institute of Biological Sciences.

Dr. Bassett Maguire, head curator and coordinator of tropical research at The New York Botanical Garden, has been appointed adjunct professor of botany at Columbia University by the Board of Trustees of the University.

Dr. Arnold W. Ravin, Associate Dean of the College of Arts and Science and Associate Professor of Biology at the University of Rochester, has been named Dean of the College of Arts and Science for 1961-62. Dr. Ravin, 40, will fill the post vacated by Dr. McCrea Hazlett, who recently was named Provost of the University for the coming academic year.

Dr. Ernst Mayr, will become Director of Harvard's Museum of Comparative Zoology on July 1. Founded by the great 19th century naturalist Louis Agassiz, the MCZ is one of the major centers of natural history research in the United States.

Dr. Claude Bissell, president of the University of Toronto, has announced the appointment of Dr. W. E. Swinton, formerly of the British Museum (Natural History), as Head of the Life Sciences Division, Royal Ontario Museum. Dr. Swinton succeeds Dr. F. A. Urquhart, who resigned in the early spring of 1961 to devote his time to research and teaching at the University.

Dr. Charles S. Thornton of Kenyon College, Ohio, has been named professor and head of the zoology department at Michigan State University. Dr. Thornton will succeed Dr. Karl A. Stiles, who will retire on July 1, 1962, according to an announcement by the Board of Trustees Thursday (June 15).

Dr. Frederic W. Nordsiek has been appointed Scientific Associate to Dr. J. R. Heller, President of Memorial Sloan-Kettering Cancer Center, it was announced by Dr. Heller today. Dr. Nordsiek will also serve as Chief of Grants and Fellowships for the Sloan-Kettering Institute for Cancer Research, the research unit of the Center.

Meetings

The annual convention of the American Documentation Institute will be held November 6-8 at the Somerset Hotel, Boston, Massachusetts. A State of the Art Symposium sponsored by the National Science Foundation has been scheduled for Tuesday, November 7 at Kresge Auditorium, M.I.T.

For information concerning this symposium, contact: P. D. Vachon, Literature Physicist, Melpar, Inc., Applied Science Division, 11 Galen Street, Watertown 72, Mass. Technical papers on documentation and related subjects are solicited for the volunteer papers session schedules for Wednesday, November 8. For further details on these papers write to: Dr. Richard H. Orr, Director, Institute for Advancement of Medical Communication, 33 East 68th Street, New York 21, New York.

The American Vacuum Society will serve as host to the **Second International Congress for Vacuum Science and Technology,** October 16-19, 1961 at the Sheraton Park Hotel, Washington, D.C. The Congress will provide a forum for the discussion of the latest developments in vacuum science and technology.

A conference entitled "The Cell in Mitosis" will be held November 6-8, 1961 at Wayne State University, and will be sponsored by Wayne State Alumni Fund. For further information contact: Laurence Levine, Dept. of Biology, Life Sciences Research Center, Wayne State University, Detroit 2, Michigan.

The Endocrinology Study Section of the National Institutes of Health is sponsoring a **Symposium on Neuroendocrinology** to be held on December 6, 7 and 8, 1961, at Miami, Florida. Those interested in attending should address requests for room reservations to: Neuroendocrinology Symposium, The New Everglades Hotel, Miami, Florida. For information on the symposium and for a program, contact A. V. Nalbandov, 102 Animal Genetics, University of Illinois, Urbana, Illinois.

The next meeting of the Weed Society of America will be held at the Jefferson Hotel in St. Louis, Missouri. The North Central Weed Control Conference will be host for this meeting. The program will start at 1:30 p.m. on Monday, December 11, and end at noon on Thursday, December 14. Monday morning will be available for committee meetings. A tour of the Agricultural Research Laboratories of Monsanto Chemical Company is being arranged for 10 a.m. Monday and will be repeated on Thursday at 1 p.m. Questions regarding local arrangements should be directed to the co-chairmen, Dr. D. D. Hemphill, Department of Horticulture, or Dr. O. H. Fletchall, Farm Crops Department, University of Missouri, Columbia, Missouri.

The newly formed **American Society for Cell Biology has announced its first regular meeting** and has issued a call for papers. The meeting will be held November 2, 3, and 4, 1961, in Chicago, Illinois at the Edgewater Beach Hotel. A program of three symposia, contributed papers, demonstrations and motion pictures is being arranged. The symposia with invited speakers from the U.S. and abroad, reflect the Society's aim to transcend disciplinary boundaries and bring together workers with divergent approaches in an effort to focus on fundamental problems of the cell. The topics will cover cell continuity, cell diversification, and characteristics of cell interfaces. Further information about the Society or the meeting may be obtained from the Acting Secretary, Dr. M. J. Moses, Box 2982, Duke University School of Medicine, Durham, North Carolina.

The Michigan Nucleonic Society announces an all-day scientific meeting to be held at the Ford Hospital, Detroit, on November 10, 1961. Nationally known speakers from many laboratories across the country have been invited and will include Dr. G. J. Dienes, Brookhaven National Laboratory; Dr. Bernard Smaller and Dr. W. J. Sinclair, Argonne National Laboratory; Dr. Wright Langham, Los Alamos National Laboratory; and several local speakers. A wide range of subjects in radioisotope research and radioisotope applications will be covered. Further details and the program of the meeting can be obtained from L. E. Preuss, Department of Physics, Edsel B. Ford Institute for Medical Research, Henry Ford Hospital, Detroit 2, Michigan.

An educational program entitled **"The Organization of Bio-Medical Instrumentation and Engineering in Universities and Hospitals"** has been scheduled by the University of Nebraska for October 26 and 27 at the Sheraton-Fontenelle Hotel in Omaha. Co-sponsoring this program is the Electrical Techniques in Medicine and Biology committee of the American Institute of Electrical Engineers and the Professional Group on Bio-Medical Electronics of the Institute of Radio Engineers. Hosts for the conference will be the Nebraska section of the A.I.E.E. and the Omaha-Lincoln section of the I.R.E. Program chairman is Professor Dennis LeCroisette, Drexel Institute of Technology, Philadelphia and co-chairman is Dr. F. Lowell Dunn, University of Nebraska College of Medicine, Omaha.

Recent Deaths among Biologists

J. E. Livingstone, Head of the Department of Botany and Plant Pathology at the Pennsylvania State University, at Washington, D. C., August 15

John T. Curtis, Professor of Botany at the University of Wisconsin.

Lester W. Sharp, Professor Emeritus at Cornell University, at Neuvo, California, July 17.

Ernest P. Reynolds of the Marine Laboratory of the University of Miami, in June.

Joseph Horace Faull, Professor of Forest Pathology, Emeritus, at Harvard University, at Cambridge, Massachusetts, June 30.

Reports of the Election of New Officers from the Societies

New officers for 1962 of the **Ecological Society of America** are: President, M. F. Buell; Vice President, B. H. Ketchum; Secretary, P. G. Pearson.

The Phycological Society of America reports the following new officers: President, Luigi Provasoli; Vice President, W. A. Daily; Secretary-Treasurer, Walter Herndon.

New officers of the **Mycological Society of America** are: President, Everitt S. Benecke; President Elect, Horace L. Barnett; Vice President, C. W. Hesseltine.

The following new officers have been elected by the **American Bryological Society**: President, Betty Higinbotham; Vice President, Harvey A. Miller; Secretary-Treasurer, W. A. Weber.

The Society for Industrial Microbiology reports the following new officers: President, Frederick Kavanagh; Vice President, E. L. Dulaney.

New officers of the **American Society of Plant Physiology** are: President, Harry Beevers; Vice President, Carlos Miller; Secretary, Sam Aronoff; Executive Secretary, W. Klein.

The following new officers have been elected by **The Nature Conservancy:** President, Alexander B. Adams; Vice President, Conrad Chapman; Secretary, Elting Arnold; Treasurer, C. N. Mason.

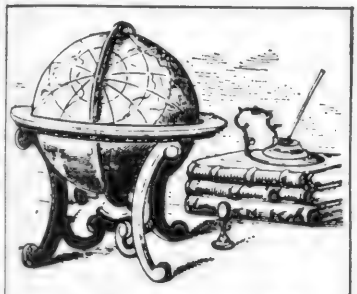
The American Society for Horticultural Science reports the following new officers: President, F. S. Jamison; Vice President, Walter Reuther; Secretary-Treasurer, R. E. Marshall.

New officers of the **American Society of Parasitologists** are: President, Leslie A. Stauber; President Elect, Gordon H. Ball; Vice President, T. vonBrand.

The **Association of Official Seed Analysts** reports the following new officers: President, E. J. Doyle; Vice President, Dwight D. Forsyth; Secretary-Treasurer, E. W. Sundermeyer.

The following new officers have been elected by the **Botanical Society of America:** President, G. Ledyard Stebbins; Vice President, David D. Keck.

The **Society for the Study of Evolution** reports the election of the following new officers for 1962: President, W. Frank Blair; President Elect, John A. Moore; Vice President, I. Michael Lerner; Secretary, H. H. Ross; Treasurer, Robert E. Beer.



AIBS REPORTS

At a time when communication among scientists of all nations is vital not only to the growth, but also to the survival of the free world, AIBS attaches immeasurable significance to its contacts with foreign biologists, and to **The Asia Foundation Grant** which has made many of these contacts possible.

Funds allocated to the Institute in 1959 by The Asia Foundation have enabled AIBS to award 3-year memberships to approximately 175 students in 13 Asian countries. With their membership, they are entitled to receive the *AIBS Bulletin* and are eligible for discounts on numerous AIBS publications. A booklet listing these publications was mailed them with a congratulatory letter from the Executive Director of AIBS when the awards were issued. Responses to the letter and to the offer of discounts have been numerous and enthusiastic.

Imminently, AIBS will distribute to these biologists the UNESCO Coupon brochure, in an attempt to promote further scientific activity.

Two Asian biologists aided by The Asia Foundation funds have attended the annual meetings of AIBS societies.

With the goal in view of establishing more active relations with Asian biologists, AIBS has established contact with various embassies. One immediate result of this liaison has been the compilation of several lists of Asian students who are temporarily residing in the U.S., and who may, in the future, be able to avail themselves of The Asia Foundation Grant funds to attend scientific meetings.

On July 15, 1961, **Mr. Charles A. Ossola,** recently with the U.S. Science Exhibit, joined the AIBS staff as Administrator.

After a costly study of procedures it became apparent, last fall, that AIBS required a more rapid method in the handling of its **membership addressing operations.** For many reasons, it was recommended that we adopt a punched-tape compatible with an automatic graphotype machine. It was also suggested that this punched tape be compatible with punched-card equipment, if possible, in the event that at a later date it would be necessary for other operations. Furthermore, consideration was given to future operations of the National Register of Scientific and Technical Personnel and the possibility of using this punched-tape in connection with Register data processing.

Naturally, our system had to be revamped to install equipment of this type. However, no major problems were encountered in connection with the transition, and as of June 16, 1961 this system has been in effect.

In the near future, AIBS will publish a new manual for the benefit of Member Societies to assist them in the use of this new equipment.

AIBS Publications

The eighth and ninth in the series of Russian Monograph translations are now available: *Wintering of Plants* by I. M. Vasiliev, edited by Dr. J. Levitt (see Page 8); and *Monogenetic Trematodes, Their Systematics and Phylogeny* by Boris E. Bychowsky, edited by Dr. William J. Hargis, Jr.

The *Style Manual For Biological Journals,* which has been published by AIBS for the Conference of Biological Editors, is entering its 3rd printing, all in 1961. Comments from users are uniformly enthusiastic.

In June, **Martin B. Berke** joined the AIBS as assistant to the Director of Publications. Previously with the University of Pittsburgh, Special Research Staff, he has a BS in Biology, worked with the U.S. Army Chemical Center, has written radio and television programs and has done editorial work.

New AIBS Officers

Dr. Frits W. Went, director of the Missouri Botanical Garden, St. Louis, Mo., was elected president of the American Institute of Biological Sciences by the Institute's Board of Governors at Purdue University, August, 1961.

Dr. Went will succeed Dr. Tracy M. Sonneborn, Distinguished Service Professor of Zoology at Indiana University, on January 1, 1962.

A native of the Netherlands, Dr. Went obtained his Ph.D. at the University of Utrecht, and served for five years thereafter as a botanist with the Botanical Gardens at Buitenzorg (Bogor), Java.

He served for 25 years as professor of plant physiology at California Institute of Technology, Pasadena, before leaving there in 1958 to direct the Missouri Botanical Garden.

A specialist in environmental influences on plant growth, Dr. Went is a member of the National Academy of Sciences, a Correspondent of the Netherlands, Royal Belgian and French Academies, and a member of many professional and scientific organizations in this country.

In his new position he will direct the affairs of an 85,000-member organization of professional biologists.

Dr. James D. Ebert, Director of the Department of Embryology of the Carnegie Institution of Washington, and former member of the faculties of Johns Hopkins and Indiana Universities and Massachusetts Institute of Technology, was elected vice president of the Institute.

Dr. Frank P. Cullinan, Beltsville, Md., associate director of the Crops Research Division of the U.S. Department of Agriculture, was re-elected secretary-treasurer.

Dr. William C. Steere, director of the New York Botanical Garden, New York, was elected to the Executive Committee of the Institute.

Dr. George Beadle, Chancellor of the University of Chicago and Nobel-Prize winning geneticist, was re-elected an honorary adviser of the Governing Board.

Biological Sciences Communication Project

Recognizing that an acute biological literature information problem exists, the AIBS formed an ad hoc Committee to recommend action. This led to the establishment on October 18, 1960 of the **Biological Sciences Communication Project** (BSCP), operating under a grant from the National Science Foundation. The project functions under policy determined by a Steering Committee, and with detailed assistance from an executive committee.

Anticipating the growing problem in communication, and keeping in mind the needs of the average biologist, the Biological Sciences Communication Project will undertake the following large-scale programs.

1) The study, definition, and improvement of the flow of fundamental and applied biological information from the scientist producer to the scientist consumer; Emphasis being placed on traditional biology and biomedicine, bioagriculture, biooceanography, biochemistry, and biophysics.
2) The evaluation of the oral and written techniques of communication in biological sciences and the determination of the methods of increasing their impact on learning.
3) The coordination with the programs of other groups working in the field of communication, and
4) The acquisition of financial support, both public and private, for projects that fill gaps in our current knowledge of communication problems.

On the international level, two projects are currently being proposed. The Foreign Information Exchange for Life Scientists (FIELS) program will attempt to collect information on the science programs of all foreign countries, and disseminate it to the traveling biologist. The other program will seek to identify all foreign published serial literature, with a view to the future formation of a Biological Serials Record Center.

Not wishing to add to the reading burden of scientists, but feeling the need to keep up-to-date with the activities of the community of scientific communication, the BSCP has begun printing, irregularly, a "newsletter," the *BSCP Communique*. This publication is a report of the activities of the BSCP as well as news items from other sources, new journals, and forthcoming meetings. We feel that the *Communique* simplifies rather than adds to the literature load, since it gathers into a few informal pages, the abstracting of a great deal of information valuable to the community interested in biological communication.

We particularly wish to be responsive to the needs of research biologists, and therefore, want to solicit ideas, comments, and suggestions for this project.

Foreign Information Exchange for Life Scientists

The exchange of information between U.S. and foreign biological scientists is beneficial to both the advancement of science and international understanding. Yet, American biologists traveling abroad are not always creating a desirable image because they are not completely informed of the foreign scientific activities. Simply stated, scientists cannot afford the weeks of research necessary for gathering such information; neither is there one central source of this information available to the scientists.

Concern for this problem led the AIBS, Biological Sciences Communication Project (BSCP) to establish top priority on a program known as **Foreign Information Exchange for Life Scientists** (FIELS). The program is concerned with the establishment of an up-to-date central file for the use of biological scientists travelling abroad.

The file will be arranged geographically and will contain the following types of information:

1. Listing of principal scientific research organizations, laboratories, universities, etc., and the types of programs being undertaken.
2. Listing of scientific personnel by activity (including curriculum vitae, address, telephone number, etc.).
3. Scientific literature with pertinent bibliographical information.
4. Major sources of support of science in the country.
5. Background of the country (history, geography, customs, climate, language problems, government, currency, living accommodations, and food requirements).

Many sources will be utilized to obtain this information. We believe that the primary source will be the biologists of the world, the American biologist with current information on foreign scientists and scientific activities as well as foreign scientists in the United States. A second source will be representatives of government agencies in foreign countries such as embassy scientific attaches, and groups like the Office of Naval Research—London. In addition, a program is being considered to send distinguished biologists to foreign countries to determine the state of the art.

FIELS will present this information to requesting scientists, who will on return furnish trip reports to be used in keeping this information up-to-date.

Three countries have been chosen to begin the collection of these materials i.e. Norway, India and Uzbek of the Soviet Union. FIELS will use the knowledge gained from the study of these countries to establish long range plans for the development of a central source of international information for biological scientists.

At this time, FIELS is not sufficiently advanced to provide information to scientists. However, the FIELS Program will greatly appreciate suggestions as well as contributions to the program such as trip reports, notes and comments on international scientific experiences.

New Journals

Advances in Morphogenesis, Academic Press Inc., 111 Fifth Ave., N.Y. 3, N.Y. (1961).

American Zoologist, American Society of Zoologists, 104 Liberty Street, Utica, N.Y. Feb. (1961) Quarterly, $9.00.

Botanical Bulletin of Academia Sinica, 1:1, June 1960, H. W. Li, Director, Institute of Botany, Academia Sinica, Nanking, Taipei, Taiwan, Irregular, $2.00 per volume (one or two issues).

Chesapeake Science, 1:2, June 1960, R. J. Mansueti, Ed., Department of Research and Education, Chesapeake Biological Laboratory, Solomons, Md., Irregular. $2.00 per year.

International Society for Tropical Ecology; Bulletin; Poona, India; Jan. 1, 1961.

Jeune Naturaliste; (Joliette, Quebec Seminaire) 10 times a year, Case Postale 219, $1.00.

Journal of Theoretical Biology; J. F. Danielli, Ed., Academic Press, 111 5th Ave., N.Y. 3, N.Y.

Medical Documentation; 1:1, Jan. 1961; Dr. Otto Nacke, 21a Ehrsen, Schotmar, Mittelstrasse 29, Germany—contains articles on methodology of medical surveys, medical statistics, and mechanical selection. (free of charge).

Realities Scientifiques et Techniques Françaises; Published by SODEXPORT, 7 Rue Servandoni, Paris 6, France; bi-monthly, 8f per year.

Sabouraudia (International Society for Human and Animal Mycology) Edinburgh; January 1, 1961; E and S Livingston, LTD, 15-17 Teviot Place, Edinburgh, $12.

Biological Serial Record Center

A serious impediment to the biologist doing research is the identification and location of serial publications. Even the number of serials publishing information useful to the biologist is unknown; estimates range from 10,000 to 50,000.

Present sources of information relating to biological serials are in many instances cumbersome, incomplete, conflicting and inaccurate. The problem of maintaining any records in this area is further complicated by the rapid birth and death rate of journals in the field.

The Biological Sciences Communication Project (BSCP) is proposing a program to establish a **Biological Serial Record Center** on a world wide basis. The objectives of the center are as follows:

1. To obtain the following data pertaining to each serial title:
   - Title
   - Publisher
   - Address of publisher or issuing agency
   - Frequency of publication
   - Date of first issue
   - Price and exchange basis
   - Copyright status
   - Number of articles and number of pages published annually
   - Nature of contents
   - Language of text
   - Coverage by abstracting and indexing services
   - Editorial policy
   - Location
2. To store data in a retrievable form
3. To disseminate information on each serial through all possible media and to libraries, scientific organizations, and secondary publications on request
4. To provide, on request, answers to special queries on the serial literature of biology (e.g. prepare a list of serial titles published in the field of cytogenetics, etc.)
5. To prepare analyses at regular intervals of the world's serial literature in biology.

The primary target of the program will be to determine what biological literature exists, and what portion of it is available to American biologists. In addition to these problems it is equally important that a mechanism must be established for obtaining the serials which are not available in this country and making the best use of those which are already available.

The proposed center will be located in Washington, D.C., to take advantage of the facilities and resources of the federal library collections. Service procedures and other details are to be determined in the near future.

The Special Libraries Association (SLA) Translation Center

Located at the John Crerar Library in Chicago, the **SLA Translation Center** is a depository for unpublished foreign and domestic translation of material in all subject fields; especially science, medicine, engineering, and technology.

In January of 1959, the Center entered into a cooperative project with the Office of Technical Services (OTS) of the U.S. Department of Commerce. OTS now serves as the collection center for foreign and domestic governmental agencies, while the SLA Center continues to collect foreign and domestic translations from non-governmental sources.

The OTS is responsible for cataloging and abstracting all translations. Card catalogs; arranged by author, title, subject, serial number, journal from which translation was made, and translation call number; are maintained at the SLA Translation Center, OTS, and the Library of Congress.

All newly deposited translations are listed in a semi-monthly publication issued by OTS, *Technical Translations*. This publication lists translations obtained from all sources; translations available from commercial firms; translation work in progress in government agencies; and a list of journals translated cover-to-cover. Translations are arranged in broad subject categories and include complete bibliographical information, price, availability, and usually a brief abstract.

The growth and effectiveness of any translation center or service depends upon the contribution and cooperation of all users of that service. The SLA Translations Center urges all users to make every possible contribution for deposit in the collection. A translation gathering dust in your private file cannot make any contribution to the scientific community until such time as the material is readily available to everyone within the community. If a copy of the translation is not available for deposit, arrangements can be made to lend the Center the material for a short period of time with permission to microfilm; or a 35mm microfilm copy may be sent in place of the original material.

Permission to lend the translation or to reproduce in photocopy is a condition of the deposit. For the protection of depositors, it is stated policy of the Translations Center to delete all identification of the donor.

For further information, contact: Chief, SLA Translation Center, the John Crerar Library, 86 East Randolph Street, Chicago 1, Illinois; or Chief Office of Technical Services, Department of Commerce, Washington 25, D.C.

TV Biology Course

Beginning September 25, a **college-level biology course** will be produced for television by the Learning Resources Institute and the Columbia Broadcasting Company, in consultation with AIBS. To date, about 150 CBS-affiliated and independent educational TV stations have signed to carry the course. Learning Resources Institute is also contacting colleges and universities about plans for offering the course for credit.

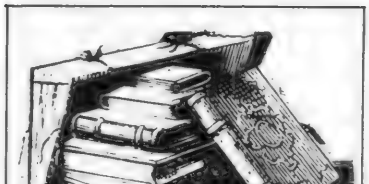
Dr. Ray Koppelman, Assistant Professor of Biochemistry at the University of Chicago, will be instructor for the course, and also is author of its text, "A Study Guide to the New Biology." The paperback text is being published in two parts by Addison-Wesley; part one on September 11, and part two in January for the beginning of the second semester. Each is priced at $2.50.

The program is to be broadcast by CBS in half-hour segments with time schedules varying from station to station.

Placement Service

Attention Employers of Biologists and Agriculturalists: The increase of requests by candidates and employers have necessitated some changes in the publication of the AIBS Placement Service Directory. Effective November 1, 1961, the Directory will be published quarterly (November, February, May, and August) at a cost of $8.00 per year. Individual copies may be purchased at a cost of $2.00.

Those **biologists and agriculturalists** who wish to have their curricula vita appear in one or more of the Quarterly Lists may do so by directing their inquiries to the AIBS Placement Service Office.



LIBRARY

One copy of each publication submitted for listing should be sent to the Editor, AIBS BULLETIN, American Institute of Biological Sciences, 2000 P Street, NW, Washington 6, D.C. Only books published within a year of receipt will be reviewed. Books marked with a ★ are those published by Bulletin advertisers.

An Introduction to the Biology of Micro-organisms. LILIAN E. HAWKER, A. H. LINTON, B. F. FOLKES, and M. J. CARLILE. 452 p., illus. St. Martin's Press Inc., 175 Fifth Avenue, New York 10. (1961) $6.75.

This new textbook by English authors at the University of Bristol is a general introduction to the morphology, physiology and ecology of the major groups of microorganisms. It is designed to cover broadly a full university course in microbiology and is suitable for students of the agricultural and biological sciences.

Section I covers the morphology and life-cycles of bacteria, fungi, protozoa, slime molds, algae and viruses. Section II includes discussions on physiology and metabolism, while Section III is devoted to soil, air, water, food, industrial fermentation, plant and animal diseases. Some techniques used in the study of microorganisms are placed in an appendix.

The book is written in a very readable but concise manner for students who have had courses in biology and organic chemistry. It is well illustrated with excellent figures and plates. Each of the 17 chapters concludes with a list of books, reviews and important articles to enable the student to pursue further any area in which he is especially interested.

Although new and important words are printed in bold face type it would be of value to the students if such terms as hypobiosis and cryptobiosis, etc., were included in a glossary.

The classification of bacteria closely follows *Bergey's Manual of Determinative Bacteriology* for the Pseudomonadales and the Eubacteriales. However, as might be expected, the authors have found it difficult to be consistent in using *Clostridium perfringens* or *Clostridium welchii*.

This book successfully accomplishes the authors' attempt to present information on important groups of microorganisms often neglected by other writers. It should serve admirably for this purpose and joins a growing list of outstanding texts for introductory microbiology. *William G. Walter, Department of Botany and Bacteriology, Montana State College, Bozeman.*

★Ecology of Inland Waters and Estuaries. GEORGE K. REID. xvi + 375 p., illus. Reinhold Publishing Corporation, New York. (1961) $7.50.

The study of the biology, chemistry, physics, and geomorphology of water bodies is complex and has been the subject of several textbooks in the past decade. Usually, these studies have been limited to either fresh water bodies or marine waters. However, more general works, principally those of Hutchinson and Allee, Emerson, Park, Park, and Schmidt, have discussed all water environments. Reid's new text, which covers inland fresh water bodies and the transitional area of the estuary where fresh waters meet the oceans, is a deserving addition to the field and should prove particularly useful to courses conducted in coastal regions.

This book is organized into five primary divisions: I) the origins and features of basins and channels; II) Water; III) Natural waters as environment (solar radiation, thermal relations, water motions, gases, dissolved solids); IV) Organisms in the environment; and V) Relationships of organisms and environment. The first three divisions, consisting of basic physico chemical principles, compose about 60 per cent of the text. The penultimate section, a relatively useless running account of the great variety of organisms encountered in lakes, streams, and estuaries, occupies an additional 15 per cent. Thus, the concepts of community ecology, emphasized by the title, are compressed largely into the final quarter of the text.

The book suffers from three main weaknesses. Its coverage is so great that the necessary condensation has resulted in rather cryptic discussions of many complex concepts. This fact will throw a considerable burden on the instructor using the book as a class text, and will make many sections of the book rather incomprehensible to an individual reader who lacks a requisite background. The second weakness is the stifling pedantry of the writing which conjures up visions of a teacher lecturing a class. There is a total absence of personality in the writing so that its compendium nature stands in stark relief. I was negatively impressed by too frequent review paragraphs and the over usage of such phrases as, "We have seen ..." The author's preference for scientific jargon also detracts from the text, especially since the book lacks a glossary. The third weakness is that the relatively extensive bibliography, comprising some 370 titles, is not correlated with the text. Under the circumstances, it is primarily an acknowledgment by the author of his main sources of information. Only about 1 per cent of the titles are in languages other than English and the majority of these were published in the 1930's.

Although this first edition of Reid's text is open to the aforementioned criticisms, its value is sufficient to insure its longevity and wide usage. It touches on many basic principles and draws illustrations from a variety of geographical settings. *Jack McCormick, The American Museum of Natural History.*

★Man in Nature. MARSTON BATES. 116 p. Foundations of Modern Biology Series, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, (1961) $1.50 (paper bound).

This is the eleventh book in a series intended to form a source of subject matter from which a biology teacher (college level?) can select readings suitable to his particular course design. In addition the author states: "The aim of this book is to explore the area of contact and overlap between biological and social sciences, to look at some of the parts of biology that provide useful background for the exploration of social studies."

One must grant that Bates succeeds as usual in captivating the reader's attention. But by many pedagogical criteria, or even in relation to the author's aim, this book falls short. Although many principles are mentioned or implied, the reader in general must look elsewhere for data to test their validity.

Bates first raises the issue that "One problem of biology and psychology, then, is to determine and describe the shift in capability that enabled man to begin the record of human achievement." Then after suggesting that a comparative biological approach may further our understanding he rejects this possibility with: "But we still do not know the genetic steps of biological evolution that made the beginning of culture

possible. An experimental approach to this mystery is impossible, since we cannot establish breeding populations of people in the laboratory for study, as we can with mice or fruit flies."

He falls into the trap of assuming that all human behavior, by the fact of its existence, becomes impossible of expression by any non-human species. For example he says that "sometimes men" (and by implication only men) "will die rather than eat food they think unfit." I have recently found that rats with certain social histories will die of thirst or starvation rather than adjust to a drinking or feeding situation slightly different from that to which they have been accustomed. Or again he expresses his negative outlook in this passage (p. 47): "Both racial and cultural conflicts are subjects for study by social scientists. There may be some ultimate biological basis, related to the basis of conflict behavior sometimes seen in other animals like the vocal fighting over territory of the howler monkeys. But this is so deeply buried under history, economics, and learned behavior that digging for it at the present time is hopeless."

This pervading irresolution between the statement of a problem and its investigation is most clear in the following (p. 92): "The health of a community clearly involves much more than freedom from disease." (Here he means infectious disease). "One could argue that the most important aspects of a community's health are far outside of biology, or even of any of the subjects ordinarily thought of as part of 'public health'. The values and satisfactions, the morals, of both individuals and groups, are surely basic to the development of a healthy society and these things can hardly be dealt with by biology, perhaps not by any science."

While recognizing that abnormal physiology, or disease, eminates from many predisposing conditions, he selects for emphasis those caused by parasitic organisms. Yet these are the least characteristic of man as the most social animal. When discussing populations he points out that heart disease, cancer, cerebral hemorrhage, and accidents in the United States now replace infectious diseases as the leading causes of death. However, he makes no effort to exploit this change despite a now voluminous literature which implicates man's culture and technology in the origin of many metabolic and behavioral disorders.

Bates repeatedly implies that man is so different from other animals, with regard to psychological, social and cultural phenomena, that comparative biological studies will fail to advance our understanding of such phenomena on the human level. A strange position to be taken by an ecologist!

From many viewpoints this book inadequately fulfills the implications of its title. *John B. Calhoun, National Institutes of Mental Health.*

★Forest Management. 2nd Edition. MEYER, RECKNAGEL, STEVENSON and BARTOO. 282 p. The Ronald Press Company, New York, N.Y. (1961) $8.50.

This second edition of Forest Management represents a notable contribution to the field of forestry. It should find a useful place in the repertory of the forestry student and on the desk of the practicing forester. The authors have succeeded in developing the subject of forest management in a clear, logical and up-to-date manner.

The book is divided into four major parts accomplishing that which is stated in the Introduction ". . . the major emphasis will be placed upon the concept of forest management as the *formalized application of technical forestry to the operation of a specific forest property.*"

Part one deals with the organization of forest property, including a discussion of the tasks of forest management, maps useful in management, the subdivision of forests, the classification of forest conditions, and forest inventory, growth, and mortality as related to the actual growing stock of the forest. Continuous Forest Inventory (CFI) is briefly discussed.

Part two dealing with regulation, presents in turn detailed discussions of the even-aged forest, the uneven-aged forest, and the regulation of the growing stock in both types of forest. This part of the book represents the major section, comprising 114 pages. Such topics as the normal and desired growing stock, the use of yield tables, forest structure, growth, and development, various types of rotations, and cutting cycles are discussed for both the even-aged and uneven-aged forests where appropriate.

The chapter on the uneven-aged forest is particularly strong and remains as the best source of information for techniques related to the study and management of this type of forest structure. It has been considerably modified from the first edition to achieve greater clarity and to incorporate recent research and experience.

The actual regulation of the growing stock is discussed in detail providing practical formulas and techniques for the calculation of the allowable cut which are representative of the methods in current use. Noteworthy additions to this part include a discussion of systems of management and a comparison of even-aged and uneven-aged growing stock.

Part three discusses the preparation of forest management plans, their control, revision and record keeping, and the forest as a business enterprise. Topics covered include the necessary components, outline, and arrangement of a management plan, and timely discussions of property appraisals, forest taxation, income taxes, timber sales, and contracts as related to a forest enterprise.

Part four covers briefly the history and present status of forest management in the United States.

Actual management plans are presented in considerable detail in the Appendix. One plan deals with a small forest property, one with a medium-sized and two with large properties located in Massachusetts, Tennessee, Idaho, and California. These are different plans from those presented in the first edition. A critique has been added by the authors after three of the plans presented.

While a few minor deletions have been made, this second edition has a considerable number of additions. Significant among those not already mentioned are more detailed subject-matter headings, the keying of tables, figures, and formulas to chapters, and suggested supplementary readings (annotated) following each chapter.

The authors have done an excellent job of revision, in this second edition, of a book already well established as a text in forest management and as an outstanding reference for all persons engaged in or interested in practical forest management. *Thomas W. Beers, Department of Forestry and Conservation, Purdue University, Lafayette, Indiana.*

THE AIBS BULLETIN *is anxious to publish articles in all fields of interest to biologists—especially illustrated articles. Average length is about 2500 words. If you have articles or cover photographs to contribute, please send them to The Editors,* AIBS BULLETIN, *2000 P Street, N.W., Washington 6, D. C.*

AAAS Denver Meeting

December 26-31, 1961

THE 128TH MEETING of the American Association for the Advancement of Science will include sessions of 18 AAAS sections and of some 75 participating organizations. Programs of particular interest to biologists are:

AAAS General Sessions. Moving Frontiers of Science: One of four distinguished lecturers will be E. W. Fager, whose general topic will be energy flow in ecological systems, Dec. 28, aft.

AAAS Interdisciplinary Symposia, Dec. 28. One of four, "Existing Levels of Radioactivity in Man and His Environment: Measurement and Significance," arranged by John E. Christian. Speakers: Wright H. Langham, Ernest C. Anderson, P. R. J. Burch, and James R. Arnold. Another, "Geochemical Evolution—the First Five Billion Years," (also Dec. 29) arranged by T. S. Lovering, who will preside at the Dec. 28 session; Essie White Cohn will preside at the Dec. 29 session. Titles and speakers for Part I, "Cosmic and Geological Aspects," will be: "Origin of the Chemical Elements," G. R. Burbidge; "Origin of the Atmosphere of the Planets," Harold C. Urey; "Geochemical Restrictions on the Environment in which Life Originated," Philip Abelson; and "The Geochemical Evolution of the Earth's Crust in the Rocky Mountain Region," A. E. J. Engel. Titles and speakers for Part II, "Minor Elements in the Biosphere and in Surface Waters," will be as follows: "Effects of Some Minor Elements on Experimental Animals and People," William H. Strain; '(Biochemical Cycle of Some Minor Elements in Plants," Perry R. Stout; "The Cycle of Vanadium in Plants," Helen Cannon; "Minor Element Content of Some Major Streams of the World," Walton Durum and Joseph Haffty; "The Content of Minor Elements in Raw and Finished Water in Some of the Major Municipal Water Supplies in the United States," Charles Durfor. Following presentation of the papers, Essie White Cohn and T. S. Lovering will give a commentary on the symposium.

AAAS Section C-Chemistry. Symposium, "Extraterrestrial Biochemistry and Biology," arranged by Charles R. Phillips, Dec. 27. Speakers: A. G. Wedum, Richard Ehrlick, Hubertus Strughold, Henry C. Stubbs, Carl Sagan, and Sidney Fox.

AAAS Section F-Zoological Sciences. Zoologists' Dinner and vice presidential address by Jack Schultz, Dec. 29.

AAAS Section G-Botanical Sciences. Two-session symposium, "Plant Biology Today: Advances and Challenges," arranged by Harriet B. Creighton, Dec. 27. Among the titles and speakers: James F. Bonner; "The Control of Plant Growth by Environment," Anton Lang; "The Problem of Cell Development," William A. Jensen; "Biological Clocks in Plants," Beatrice M. Sweeney; "Photosynthesis," Lawrence Bogorad; and "Translocation: The Movement of Dissolved Substances Within Plants," Frank Salisbury. Session for contributed papers, Dec. 26. Botanists' Luncheon and vice presidential address by James Bonner, Dec. 27.

AAAS Section N-Medical Sciences and cosponsors. Four-session symposium, "Physiological and Biochemical Aspects of Human Genetics," arranged by Alexander G. Bearn and Oscar Touster, Dec. 29, 30. Topics and speakers will be:

A. Structure and Specific Action of DNA—Paul Doty, J. Hurwitz, A. E. Mirsky;

B. Gene-Protein Relationships, Part I—C. Baglioni, D. M. Bonner, G. D. Novelli, O. Smithies;

C. Gene-Protein Relationships, Part II—R. Ceppelini, H. N. Kirkman, A. G. Motulsky, A. G. Steinberg;

D. Tissue Culture, Immunological and Evolutionary Aspects— C. L. Markert, R. D. Owen, T. T. Puck.

John B. Youmans will give his vice presidential address, and the seventeenth Theobald Smith Award will be presented, Dec. 30, aft.

Section O-Agriculture. Five-session symposium, "Land and Water Use with Special Reference to Mountain and Plains Regions," arranged by D. Wynne Thorne, Dec. 27-29. Part I, "Land and Water Resources," Part II, "Optimum Uses for Resources," Dec. 27; Part III, "Water and Climate," Dec. 28; Part IV, "Impact of Public Policy on Land and Water Use," Part V, "Projecting Management Programs," Dec. 29.

There will be a Biologists' Smoker jointly sponsored by Section F and G and all biological societies, Dec. 27.

SOCIETAL PROGRAMS

Alpha Epsilon Delta. Annual symposium, "Career Opportunities in Medicine and Dentistry," arranged by Maurice L. Moore; annual luncheon and address; Dec. 28.

American Nature Study Society. Among the sessions: "Nature Study Around the World," Richard L. Weaver presiding, Dec. 27; "Outdoor Nature Interpretation," Dec. 28; joint program with the National Association of Biology Teachers, "Resource Conservation Around the World," Dec. 28; joint field trip with NABT, Dec. 29; motion-picture film, "*Nature Adventure Around the World*, Dec. 29; sessions on "Ecology and Natural History of the Rocky Mountains," Ruth Hopson presiding, Dec. 30.

American Physiological Society. Session, "Physiological Factors in Manned Lunar Space Flight," arranged by Robert E. Smith, with Loren D. Carlson presiding, Dec. 29. Included will be: "Neurophysiological Aspects," W. Ross Adey; "Hemodynamic Evaluation at Null Gravity," Nello Pace; and a panel discussion, "Space Physiologists: Their Role, Availability and Training."

American Psychiatric Association, Committee on Research. Two-session symposium, "Genetics and Evolution in Relation to Human Behavior," arranged by David A. Hamburg, Dec. 27. Among the speakers will be Ernst Caspari, Desmond Clark, Irven DeVore, Theodosius Dobzhansky, and Sherwood Washburn.

American Society of Naturalists. Annual national meeting, arranged by Ernst W. Caspari, will feature the presidential address of Marston Bates, "Man's Ecological Niche," Dec. 27, morn. The business meeting of the society will follow.

American Society of Zoologists. Tentative program of the national meeting of the Society, arranged by Ray L. Watterson, with more than 30 sessions, includes 20 sessions for contributed papers, sponsored by all six divisions of the Society, throughout the meeting period; business meetings of five divisions; and a series of symposia. Symposia are as follows: "Neurosecretion," three sessions, arranged by Nancy S. Milburn, Dec. 28, 29; "Vertebrate Locomotion," arranged by D. Dwight Davis, Harvey I. Fisher, and How-

ard Evans, Dec. 29; "Evolutionary Changes in the Hormonal and Neural Bases of Reproductive Behavior," two sessions, arranged by William C. Young, Dec. 30; and "Cellular Endocrinology," two sessions, Dec. 30. The annual business meeting of the ASZ as a whole is planned for Dec. 29.

Beta Beta Beta Biological Society. The biennial meeting of the Society, arranged by Mrs. Frank G. Brooks, will be held Dec. 27, morn. It will be followed by the biennial luncheon and address, arranged by H. P. Sturdivant, at which Martin W. Fleck will speak.

Biomedical Information-Processing Organization. Session, arranged by Robert S. Ledley, Dec. 27, aft.

Biometric Society, Western North American Region. Three-session program, arranged by Franklin A. Graybill, Dec. 28.

Ecological Society of America. Two-session symposium, Dec. 26; other symposia and some six sessions for contributed papers on plant ecology, animal ecology, human ecology, and aquatic ecology, and a series of sessions jointly sponsored by the Section on Animal Behavior and Sociobiology and with the Division of Animal Behavior and Sociobiology of the American Society of Zoologists, arranged by Martin W. Schein; Dec. 27, 28; Human Ecologists' Luncheon, Dec. 27.

Mountain Lake Biological Station. Annual breakfast with the AAAS, arranged by Horton H. Hobbs, Jr., for all persons who have been students, investigators, or staff members at the station.

National Association of Biology Teachers. Annual national meeting, Dec. 26-30. Included in the program will be the NABT presidential address and luncheon, Dec. 28, and a series of separate sessions, Dec. 27, 29, and 30, with the theme "Accent on Investigation."

Nature Conservancy. Meeting of the Conservancy's National Committee for Natural Areas for Schools, arranged by John W. Brainerd.

Sigma Delta Epsilon. Regional meeting, arranged by Ernestine B. Thurman, will include a tea for all women in science.

Society for Industrial and Applied Mathematics. Session, arranged by D. L. Thomsen, Jr., "Biology and Mathematics," Dec. 29, aft.

Society of Protozoologists. Fourteenth annual meeting, arranged by Norman D. Levine, includes some six sessions for contributed papers, Dec. 27-30, and a round-table symposium, "Biochemical Phyletic Markers Among the Protozoa," arranged by Seymour H. Hutner. Among the titles and speakers at the symposium will be: "Are There Biochemical Boundaries to a Phylum Protozoa?", Ellsworth C. Dougherty; "Which Protozoa (if any) Should Be Called Humanoid?", S. H. Hutner; and "Biochemical Intimations of the Phylogenetic Position of the Ciliates," G. G. Holz, Jr. Annual luncheon and business meeting, Dec. 29.

Society of Systematic Zoology. Annual meeting will include sessions for contributed papers, annual breakfast and business meeting, Dec. 30; three-session symposium, "The Data of Classification," arranged by R. E. Blackwelder, Dec. 27, 28; and a symposium, "The Biogeography of the Philippine Islands."

Society of the Sigma Xi. Sixty-second annual convention, joint luncheon with the Scientific Research Society of America, and joint address with Phi Beta Kappa, by Harrison Brown; Dec. 29.

The AAAS Exposition of Science and Industry and the AAAS Science Theatre, with recent foreign and domestic films, will be prominent features of the meeting. Coupons for sleeping accommodations and advance registration will be found in *Science*, beginning July 21.

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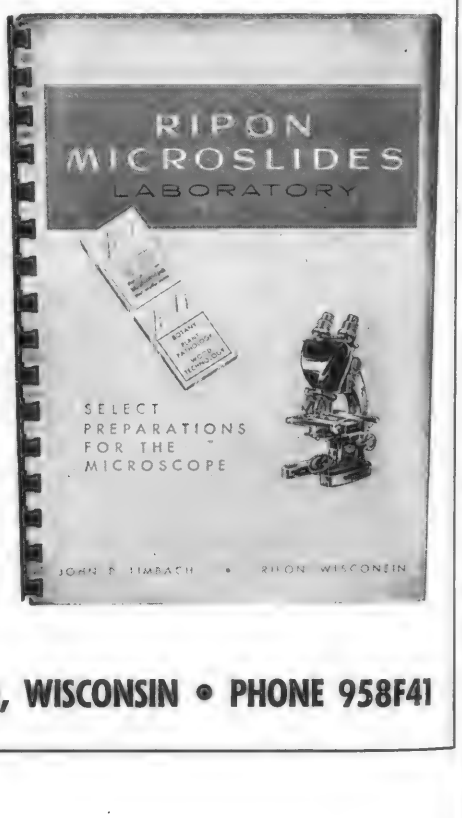

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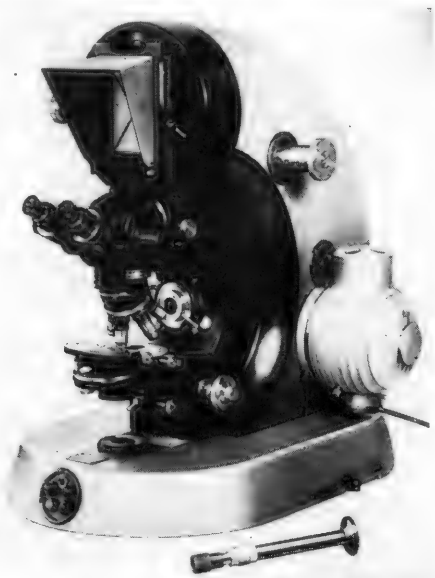

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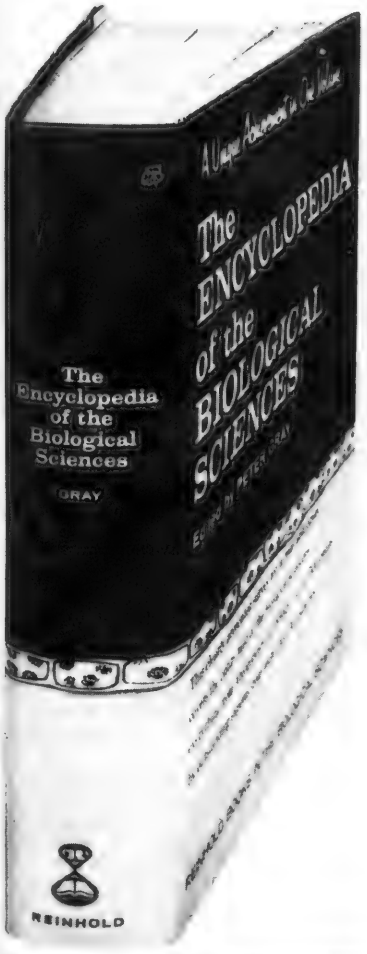

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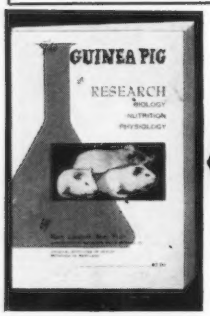

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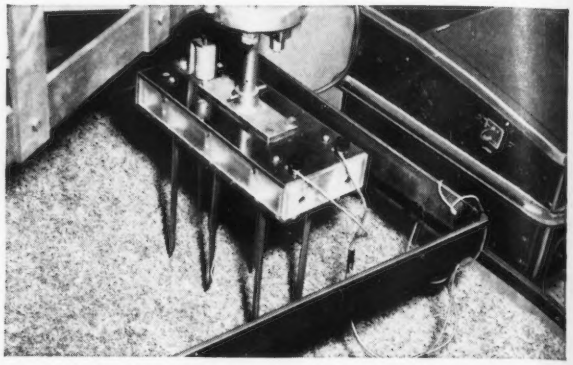

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